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Final
Work Plan

Background Investigation and Hot Spot Groundwater Remediation Pilot Testing SWMUs 1, 2B, and 24

Naval Air Station Oceana
Virginia Beach, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Contract No. 62470-95-D-6007
CTO-0267

January 2003

Prepared by

CH2MHILL

01/01/03-00632

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1 Introduction

This work plan describes the work that will be completed for the background groundwater investigation and hot spot groundwater remediation pilot testing at the Naval Air Station (NAS) Oceana, Virginia Beach, Virginia (Figure 1-1). This work plan is based on a Scope of Work (SOW) provided by the Naval Facilities Engineering Command (NAVFACENGCOM) Atlantic Division (LANTDIV) as part of Navy Contract N62470-95-D-6007, Comprehensive Long-term Environmental Action Navy (CLEAN), District III, Contract Task Order 0267. The technical approach is documented in CH2M HILL's Implementation Plan (IP), which was submitted to LANTDIV in August 2002, and based upon the scope provided.

The general background and physical setting of NAS Oceana is described in Section 2 of this report.

This work plan addresses two activities to be performed at NAS Oceana:

- Installation and sampling of 13 monitoring wells at non-impacted locations to establish background concentrations of Arsenic (As), Iron (Fe), Manganese (Mn), and Lead (Pb).
- Sampling and analysis of specific organic constituents that exceed Maximum Contaminant Levels (MCLs) or calculated human health-based Preliminary Remediation Goals (PRGs) at individual monitoring wells at SWMUs 1, 2B, and 24. The data evaluation will be used to develop and compare potential in-situ "hot spot" remediation alternatives at these 14 monitoring wells.

For the basewide background groundwater investigation, basewide inorganic concentrations will be compared to SWMU-specific inorganic data that currently exceed MCLs/PRGs. A second round of sampling will be conducted 6 months after the initial well installation and groundwater sampling to evaluate potential seasonal variation. The first round of groundwater sampling will be followed by a statistical evaluation of the data to determine upper tolerance limits (UTLs) or other applicable statistical values for comparison to SWMU-specific concentrations. The data will be re-evaluated and updated after the 6-month sampling event is completed.

The 14 monitoring wells to be sampled for specific organics have been shown, during previous investigations, to exceed MCLs and/or PRGs. Following the initial round of sampling, analytical results will be evaluated to assess which locations still exceed MCLs and/or PRGs. Locations that exceed these criteria will be evaluated for localized hot spot remediation. A potential remedial strategy is the enhanced biological degradation via the injection of reagents such as hydrogen releasing compound (HRC), potassium permanganate, or an iron solution, among others. The hot spot remediation will be determined once the first round of sampling is collected and evaluated against potential reagent/injection alternatives. The first round of sample results will be documented in a technical memorandum summarizing the proposed remediation.

Sampling of these 14 monitoring wells will then be conducted again after 6 weeks from the time of injection (regardless of whether the monitoring well required injection or not),

followed by 3 month-, 6 month-, and 9 month-intervals. The sixth month interval (third round) sampling event will also include sampling the inorganic constituents (As, Fe, Mn and Pb) at SWMUs 1, 2B, and 24 that were found to be above the statistical values (UTLs or other appropriate statistical value) determined from the initial background sampling. A summary report will be prepared for these activities including results, conclusions and recommendations.

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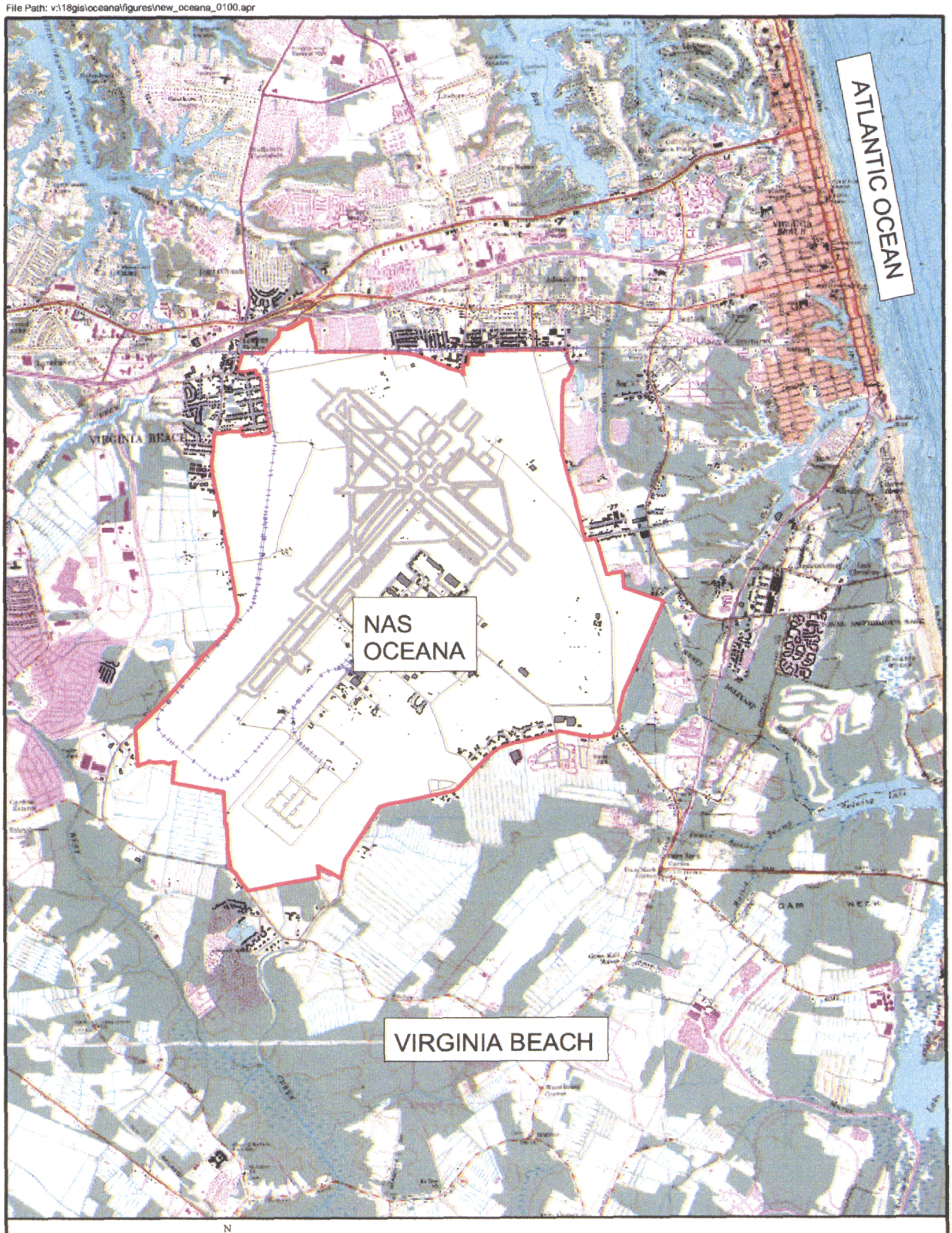

Figure 1-1
Base Location Map
NAS Oceana Work Plan
Virginia Beach, Virginia

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2 Site Background, Physical Setting, and Subsurface Geology

NAS Oceana has been in existence since 1940 when it was established as a small auxiliary airfield. Since 1940, NAS Oceana has grown to more than 9,100 Navy personnel and 11,000 dependents. The primary mission of NAS Oceana is to provide the personnel, operations, maintenance, and training facilities to ensure that fighter and attack squadrons on aircraft carriers of the U.S. Atlantic Fleet are ready for deployment. Figure 2-1 shows the locations of SWMUs 1, 2B, and 24 within NAS Oceana.

2.1 SWMU 1

SWMU 1, the West Woods Oil Disposal Pit, is located in the northwest part of NAS Oceana (Figure 2-1). According to the Initial assessment Study (IAS), the SWMU was originally an open pit where about 110,000 gallons of waste oil, fuels (such as JP-5, JP-3, and aviation gas), PD680, various chlorinated and aromatic hydrocarbons (trichlorotrifluoromethane, benzene, toluene, and naphthalene), aircraft-maintenance chemicals, paints, paint thinners and strippers, and agitine, were disposed of from the mid-1950s to the late 1960s (RGH, 1984). Drilling at this unit has shown that metal, concrete, and other debris were also disposed of in the pit or were included in the fill material. A 1958 aerial photograph of the unit shows that the pit was approximately 50 to 100 feet in diameter.

In the late 1960s, the oil disposal pit flooded and its contents are believed to have washed into the main drainage ditch, 100 feet west of the pit. Waste disposal was discontinued and the pit was filled with soil (RGH, 1984). The NAS boundary is approximately 1,000 to 2,000 feet west or northwest of the oil pit. This engineered drainage pit is part of the NAS Oceana stormwater and spill control system that is maintained, as required, to ensure designed functionality. As such, the NAS Oceana Environmental Division monitors the ditch downstream of SWMU 1 as part of the station's Virginia Pollution Discharge elimination System (VPDES) monitoring program. The VPDES monitoring is required as the ditch is a spill control device (not to monitor contaminants). As the maintenance of this ditch is not on an established or regular cycle, the ecological habitat in its current state was conservatively evaluated as an aquatic habitat in the ecological risk assessment performed at the site. The Final ERA for SWMU 1 concluded that this ditch has a low to negligible potential for risk to aquatic organisms.

The immediate area around the pit is dominated by trees, shrubs, grass, and herbs. Although forested in the past, the trees around the SWMU have been cut and the site and surrounding area is now maintained to limit the heights of woody plants. A small fresh-water emergent wetland is located approximately 250 feet east of the SWMU. The eastern perimeter of the SWMU is comprised of mowed and old field grasses and impervious surfaces. Surface drainage is directed toward north-south and east-west oriented drainage ditches. The north-south (main) drainage ditch has a permanent flow of surface water to the north. The ditch is approximately 12-15 feet wide with steep side slopes about 5 feet high.

The ditch generally maintains a low-volume baseflow because it is excavated to a depth below the water table during normal precipitation conditions. No vegetation has been observed in the stormwater drainage ditch and the ditch receives periodic maintenance to maintain unimpeded stormwater conveyance. A second east-west trending tributary drainage ditch is located south of SWMU 1 and conveys stormwater drainage west into the main drainage ditch. This tributary ditch is perched approximately 2 feet above the base of the main drainage ditch and is dry except during heavy precipitation events. This ditch contains small shrubs and grass and oxidized, non-saturated soils. It does not provide significant habitat for aquatic life.

SWMU 1 is underlain by silt, sand, and silty sand in three distinct lithological units that are generally consistent across the site. The uppermost unit is a brown silt or sandy silt that is generally consistent across the site The uppermost unit is a brown silt or sandy silt that is 4.5 to 6 feet thick and appears to have a low permeability. Beneath the silt, an 11- to 13-foot thick clean, fine, to very coarse gray sand extends to a depth of 16 to 19 feet. The shallow monitoring wells are screened in this sand unit. Underlying the clean gray sand is a third lithological unit composed of very fine greenish-gray silty sand or sandy silt. The sand in this unit is extremely fine, only slightly coarser than a fine silt. The appearance of shells in this unit is coincident with the top of the Yorktown Formation. Shallow groundwater flow was determined to be westerly directed, towards the drainage ditch, which serves as a hydrologic boundary and place of discharge for the localized groundwater flow system. The depth to groundwater at SWMU 1 is generally 5-6 feet below ground surface (bgs).

2.2 SWMU 2B

SWMU 2B is located near the geographic center of NAS Oceana (Figure 2-1). The site is southeast of the main MATWING hangar 122 and includes Line Shacks 130 through 134 and the five aircraft cleaning stations northeast of Line Shack 130.

The Initial Assessment Study (IAS) stated that oil, hydraulic fluid, turco, paint stripper and thinners, PD 680, and aromatic hydrocarbons (naphtha, benzene, toluene, and derivatives) were used in aircraft maintenance activities at SWMU 2B. These waste oils and aircraft-maintenance chemicals were disposed of adjacent to the line shacks in unknown amounts beginning in 1963, when the line shacks were constructed, until the early 1980s. A hazardous waste collection and recycling program has been in force throughout the base since 1981. During the 1980s an oil-water separator system was installed in the aircraft cleaning area northeast of Line Shack 130 to separate oil from wash water flowing from the aircraft cleaning area (RGH, 1984).

Construction of a new corrosion control hangar and extension of the flight-line were recently completed near SWMU 2B. Much of the ground surface in the immediate area of the Line Shacks is covered with concrete or asphalt, and the ground surface that is not covered has been heavily disturbed as a results of the construction of the Aircraft Maintenance Hangar and the extension of the flight line. After construction was complete, the limited exposed ground surface between the buildings, parking areas, and tarmac was graded, planted with grass, and is maintained as mowed lawn. A fence surrounds the impervious surfaces and separates the developed portion of the area from the underdeveloped portion. Most of the site

is within the flight line. The flat terrain is interrupted only by a storm water drainage ditch and a few berms left from previous disturbances.

With the exception of a short reach, the ditch was cleaned out in late 2000 to a depth of 6 to 18 inches downstream of the site, all the way to the golf course. The sediments that were removed were disposed of at an approved landfill. Drains within the aircraft cleaning area of SWMU 2B direct runoff to oil-water separators before discharging to sanitary sewers. Thus, this area of the SWMU 2B does not currently contribute to the potential occurrence of contamination in the drainage ditches.

SWMU 2B contains a storm water drainage ditch that is used to convey surface runoff from the site to the southeast. Groundwater discharges to the ditch, which maintains a perennial base flow. Data show that shallow groundwater flow is to the southeast over most of the area from Line Shacks 138 to 134, but it is to the southwest northwest of Line Shacks 132, 133, and 134 (CH2M HILL, 1993). No submerged aquatic vegetation was observed in the ditch. Vegetation includes bamboo, sweetgum, (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and some shrubs. This drainage ditch originates at the end of a pipe which collects storm water runoff from parking lots, roads, and other impervious surfaces in this section of the base.

The subsurface at SWMU 2B consists of three stratigraphic units. The uppermost unit is a 4- to 7-foot thick unit of fine sediments, mainly silty clays and sandy silts. This is underlain by a 15- to 20-foot layer of clean, fine to medium sand. These two units correspond to the Columbia Group sediments. The Columbia Group is underlain by the Yorktown Formation, which is silty sand interlayered with zones of cleaner sand to a depth of 55 feet below the ground surface. Shells and shell hash indicative of the top of the Yorktown Formation were typically encountered at approximately 25 feet.

Based on current survey and water-level data, the groundwater flow in the vicinity of SWMU 2B is generally southerly with localized groundwater flow toward nearby stormwater drainage channels. The average velocity of horizontal groundwater flow in the surficial aquifer is approximately 75 feet per year.

2.3 SWMU 24

SWMU 24 is located in the southern portion of NAS Oceana area near Building 840. Building 840 is in an industrial area and formerly contained a waste-oil bowser (Figure 2-1). The Naval Construction Battalion (SEABEEs) has been based in Building 840 since 1972. Waste solvents and oils generated at the equipment maintenance garage in Building 840 were hand carried and poured into the bowser, which was typically located in the southern-most corner of the SEABEE compound (USEPA, 1988). The bowser was then transported to the tank farm for disposal. During the visual site inspection, heavy staining of the ground was observed in the area surrounding the waste oil bowser at Building 840 (USEPA, 1988). Current practice is to dispose of waste oil in drums that are transported to the base hazardous waste lot, where they are disposed or recycled appropriately. The bowsers are no longer used. The site consists of a fenced gravel area surrounded by a perimeter of brush, forest, and mowed lawn. There is limited wildlife habitat in the immediate area of SWMU 24. Wildlife inhabits the forested area surrounding SWMU 24.

Geological cross sections indicate that the top of the Yorktown aquifer is approximately 25 feet below the ground surface. A clayey-silt unit underlies the southern portion of the SWMU in the vicinity of 24-MW7. Water levels measured in November 1998 indicate groundwater flow directions to the south and southwest across the site.

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Figure 2-1
SWMUs 1, 2B, 2E & 24
NAS Ocena Work Plan
Virginia Beach, Virginia

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3 Previous Investigations

Various site-wide studies and investigations have been completed at SWMUs 1, 2B, and 24 at Naval Air Station Oceana since 1984. A summary of the significant studies conducted to date at NAS Oceana is provided in the following sections.

3.1 SWMU 1

Previous investigations at SWMU 1 include: Initial Assessment Study (IAS),Phase I Verification Study, Interim RCRA Facility Investigation (RFA), Phase I RFI, Corrective Measures Study (CMS), Phase III RFI, Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA). Table 3-1 presents each investigation or study, the company conducting the work, when the work was completed, and the relevant findings/ results.

The results of the Human Health Risk Assessment (CH2M HILL, January 2001) indicated napthalene would present a risk above the USEPA's target range during future residential use of groundwater. Benzene has also been found (November 1998 groundwater sampling) to slightly exceed the MCL (although benzene does not pose a potential human health risk) and will be retained as a chemical of concern (COC) for the purpose of sampling. These two constituents appear to be localized exceedances at specific monitoring wells (no plume has been identified) and are the focus of the hot spot remediation. Table 3-2 presents the specific constituents that are the focus of the hot spot remediation at SWMU 1. Figure 3-1 shows the most recent analytical data on napthalene and benzene that has been collected at the two monitoring wells at SWMU 1 being investigated as part of this investigation.

3.2 SWMU 2B

Previous investigations at SWMU 2B include the Round 1 Verification Study, Line Shack Site Inspection, Interim RFI, Phase I RFI, Corrective Measures Study, Phase III RFI, Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA). Table 3-3 presents the previous investigations performed at SWMU 2B, as well as the group performing the work, when the work took place, and the relevant findings/results.

The results of the HHRA indicated the only potential scenario resulting in hazards and risks is future residential use of the shallow groundwater (from arsenic, iron, manganese, cis-1,2-dichloroethene, trichloroethene, vinyl chloride). Arsenic, iron, and manganese are not being addressed initially as part of the hot spot remediation, but will be compared to basewide "background" concentrations being obtained as part of the concurrent basewide investigation. During the February 2000 groundwater monitoring event, bis(2-ethylhexyl)phthalate, 1,1-dichlorethene, and benzene were detected at concentrations above their respective MCL (however do not pose potential human health risks). These organic compounds that exceed MCL and/or PRGs and have been identified as COCs are the focus of this hot spot remediation at SWMU 2B and are listed in Table 3-4. The inorganic

constituents will be compared to base-wide background data, which is being addressed concurrent to this hot spot remediation. Figure 3-2 shows the monitoring wells at SWMU 2B that contain these constituents and will be evaluated during hot spot sampling and remediation.

3.3 SWMU 24

Previous investigations at SWMU 24 include a RCRA Facility Assessment (RFA), Phase I RFI, POL-CMS Phase II RFI, Phase III RFI, CMS for groundwater, and DPT and groundwater sampling. Table 3-5 presents the previous investigations performed at SWMU 24, along with the group performing the work, when the work was conducted, and the relevant findings/results.

The results of the Human Health Risk Assessment (CH2M HILL, January 2001) indicated arsenic, iron, manganese, and cis-1,2-dichlorethene would present a risk above the USEPA's target range from future residential use of groundwater. Vinyl chloride, trichloroethene, and lead have also been detected during a July 1999 sampling event at concentrations above their respective MCLs and were retained as COCs for the purpose of sampling. The inorganics arsenic, iron, manganese, and lead are not associated with the hot spot remediation, but are being compared against basewide concentrations as part of the concurrent background inorganic investigation being conducted. The organic constituents of concern at SMWU 24 are listed in Table 3-6. Figure 3-3 shows the specific constituents and monitoring wells that are to be addressed at SWMU 24 as part of the hot spot remediation.

TABLE 3-1
Previous Investigations at SWMU 1

Report	Completed By	Year	Summary of Findings
Initial Assessment Study	Rogers, Golden & Halpern (RGH)	1984	Identified the site and inventoried types of wastes disposed of at SWMU 1.
Phase I Verification Study	CH2M HILL	1986	Showed groundwater, and sediment from drainage ditch west of former oil disposal pit, was contaminated with compounds associated with petroleum hydrocarbons.
Interim RCRA Facility Investigation	CH2M HILL	1991	Same conclusions as Phase I Verification Study.
Phase I RCRA Facility Investigation	CH2M HILL	1993	Determined vertical and lateral extent of groundwater contamination and hydraulic characteristics and flow regime of shallow aquifer. Benzene observed above MCL. Free product visually observed in several wells. Petroleum also detected in soil, sediment and surface water around pit.
Corrective Measures Study	CH2M HILL	1995	Determined the extent of contamination in soil and developed remedial alternatives. Recommended pulsed-pump extraction of free product.
Phase III RCRA Facility Investigation	CH2M HILL	1997	No significant changes in site conditions were observed since the 1995 CMS; Remediation involved initiating 2 solar-powered skimmers to recover free product from 4 wells (2 wells per skimmer).
Human Health Risk Assessment	CH2M HILL	2000	Only potential scenario resulting in hazards or risks is future residential use of the groundwater at the site, which is highly unlikely.
Ecological Risk Assessment	CH2M HILL	2001	Risks to species present at the site were determined to be negligible. Remedial actions were not recommended for sediment, surface water, or surface soils.

TABLE 3-2
Contaminant of Concern and Preliminary Remediation Goal in Groundwater at SWMU 1

Contaminant of Concern	Maximum Detected Concentration (µg/L)	Human Health Residential Scenario Risk-Based PRG (µg/L)	Maximum Contaminant Level (µg/L)
Benzene	6	-	5
Naphthalene	208	170	-

TABLE 3-3
Previous Investigation at SWMU 2B

Investigation	Completed By	Year	Summary of Findings
Round 1 Verification Study	CH2M HILL	1986	Groundwater is contaminated with chlorinated organic compounds from 2 or more sources.
Line Shack Site Inspection	CH2M HILL	1988	Groundwater is contaminated with chlorinated organic compounds from 2 or more sources.
Interim RCRA Facility Investigation	CH2M HILL	1990	Groundwater is contaminated with chlorinated organic compounds from 2 or more sources.
Phase I RCRA Facility Investigation	CH2M HILL	1993	Defined sources of groundwater contamination and sources areas through sampling, and defined the effects of groundwater discharge to surface water and sediment quality.
Corrective Measures Study	CH2M HILL	1995	Further delineated extent of groundwater, soil, and surface water/sediment contamination and determined need for remedial activities.
Phase III RCRA Facility Investigation	CH2M HILL	1997	Performed follow-up sediment sampling to further characterize sediment contamination at SWMU 2B.
Human Health Risk Assessment	CH2M HILL	2000	Only potential scenario resulting in hazards and risks is future residential use of the shallow aquifer groundwater, which is highly unlikely.
Ecological Risk Assessment	CH2M HILL	2001	Some small areas that have exceedances of screening criteria, but these areas are isolated and not migrating to other areas. No further action recommended on the basis of ecological concerns.

TABLE 3-4
Contaminants of Concern and Preliminary Remediation Goals in Groundwater at SWMU 2B

Contaminant Of Concern	Maximum Detected Concentration (µg/L)	Human Health Residential Scenario Risk-Based PRG (µg/L)	Maximum Contaminant Level (µg/L)
cis-1,2-DCE	120	-	70
TCE	14	-	5
VC	13	-	2
Bis(2-ethylhexyl)phthalate	30	-	6
Benzene	6	-	5
1,1-DCE	11	-	7

TABLE 3-5
Previous Investigations at SWMU 24

Investigation	Completed By	Year	Summary of Findings
RCRA Facility Assessment	USEPA	1988	Identified tank farm as SWMU 15 and documented recommendations for additional investigation.
Phase I RCRA Facility Investigation	CH2M HILL	1993	Delineated source area and extent of POL-contaminated soil. Results indicated that SWMU 24 should be characterized for soil removal.
POL-Corrective Measures Study	CH2M HILL	1994	Delineated soils for removal. Groundwater contamination discovered.
Phase II RFI	CH2M HILL	1995	Addressed groundwater contamination.
Phase III RCRA Facility Investigation	CH2M HILL	1997	After excavation, soil samples collected to confirm that POL soil removal was effective. Showed that removal was successful.
Corrective Measures Study for Groundwater	CH2M HILL	1995	Indicated that groundwater contaminated with chlorinated VOCs and BTEX.
Direct-Push Technology & Groundwater Sampling	CH2M HILL	1998	Determined boundaries of *cis*-1,2-DCE groundwater plume and assessed overall effectiveness of No VOCs remediation pilot study performed in 1996 and 1997. Monitoring wells sampled. *Cis*-1,2-DCE, TCE, and benzene exceeded criteria at several sample locations.
Human Health Risk Assessment	CH2M HILL	2000	Unacceptable risks present to a future resident for potential exposure from groundwater. Only potential scenario resulting in hazards or risks is future residential use of site, which is highly unlikely.
Ecological Risk Assessment	CH2M HILL	2001	No further action recommended based on ecological considerations. No complete exposure pathways exist. Contaminated soils removed in 1994.

TABLE 3-6
Contaminants of Concern and Preliminary Remediation Goals in Groundwater at SWMU 24

Contaminant Of Concern	Maximum Detected Concentration (µg/L)	Human Health Residential Scenario Risk-Based PRG (µg/L)	Maximum Contaminant Level (µg/L)
cis-1,2-DCE	500	-	70
VC	2.5	-	2
TCE	8.8	-	5

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LEGEND

- Piezometer
- Monitoring Well
- Site Boundary

N

0 200 400 Feet

Figure 3-1
Monitoring Wells and Piezometers with MCL and Human Health Risk-Based PRG Exceedances at SWMU 1
NAS Oceana Work Plan
Virginia Beach, Virginia

CH2MHILL

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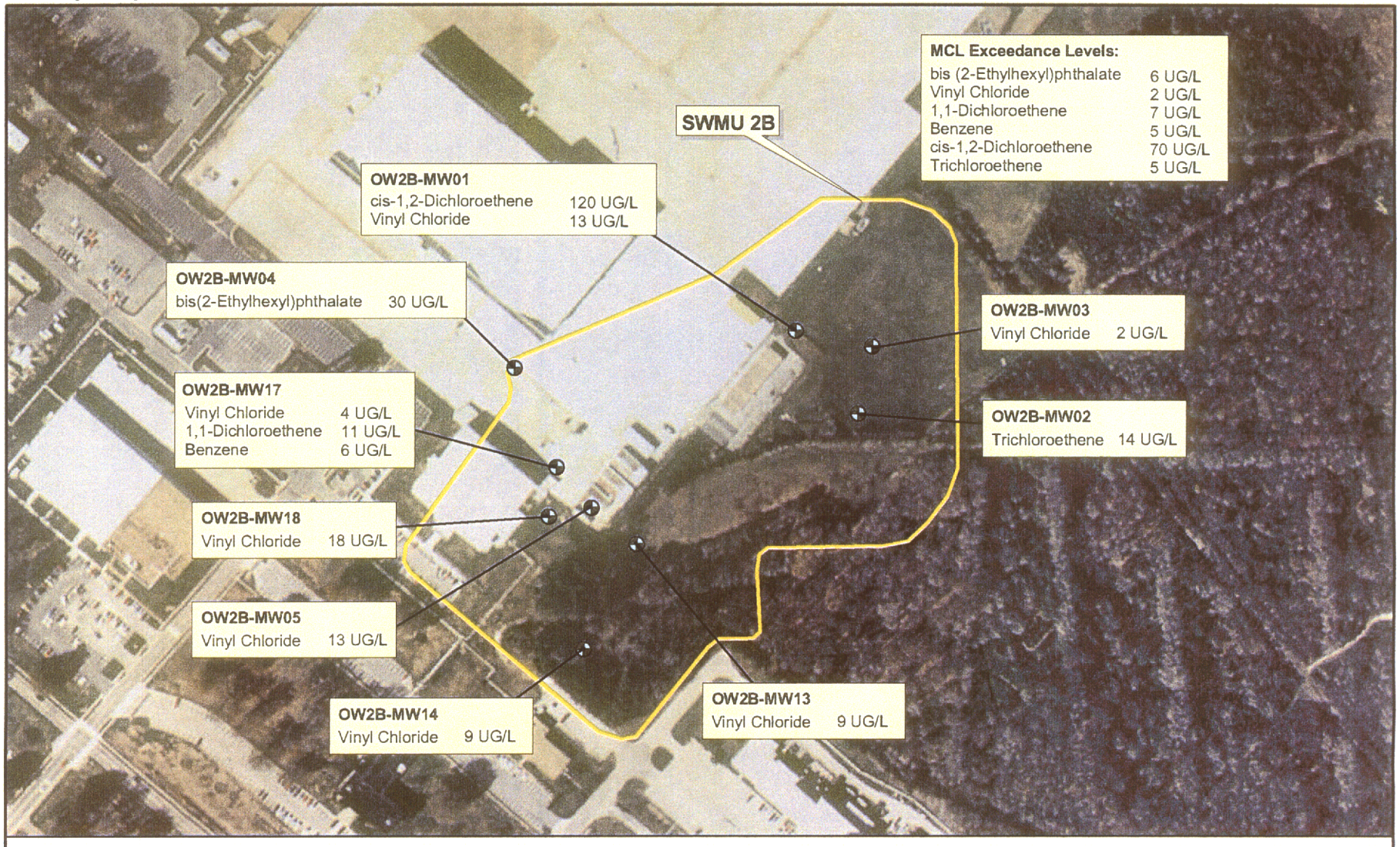

LEGEND

- Monitoring Well
- Site Boundary

N

200 0 200 400 Feet

Figure 3-2
Monitoring Wells With MCL Exceedances at SWMU 2B
NAS Oceana Work Plan
Virginia Beach, Virginia

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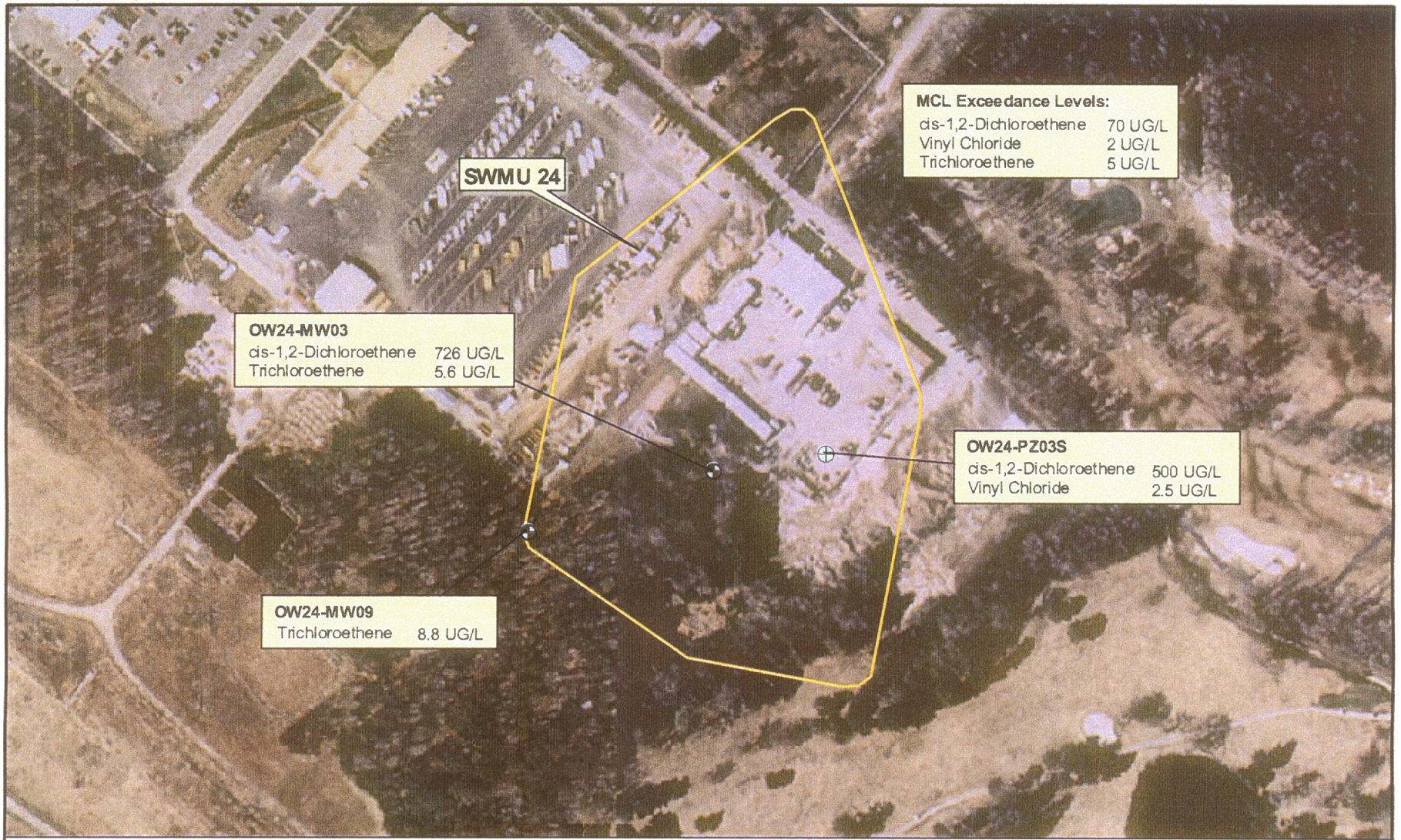


LEGEND

- Piezometer
- Monitoring Well
- Site Boundary

N

0 100 200 Feet

Figure 3-3
Monitoring Wells and Piezometers with
MCL Exceedances at SWMU 24
NAS Oceana Work Plan
Virginia Beach, Virginia

CH2MHILL

4 Work Plan Rationale

This section presents the rationale for this work plan to complete the groundwater background investigation and hot spot groundwater remediation pilot testing proposed at NAS Oceana, Virginia Beach, VA. The goal of the groundwater background investigation is to determine whether the concentrations of inorganics detected above MCLs or PRGs at SWMUs throughout NAS Oceana are consistent with basewide concentrations or appear to be site-related. The hot spot remediation of detected organic constituents at the SWMUs (those without a discernible plume) has been recommended (consensus decision) by the Tier I NAS Oceana partnering team because it is anticipated to be a cost-effective alternative to land use controls and long-term monitoring at these SWMUs. These efforts combined may be sufficient to make a no action determination at each of these SWMUs. The following subsections present the technical approach that will be followed to accomplish these goals. A Site-Specific Health and Safety Plan is included in Appendix A. Details of the technical approach and standard operating procedures (SOPs) for each task can be found in Appendix B.

4.1 Investigation Tasks

The major tasks associated with this investigation are project planning, field investigation, sample analysis and validation, pilot testing, preparation of a Background Investigation Report, and hot spot remediation for specific organic constituents at SWMUs 1, 2B, and 24. The following subsections describe in more detail what is included in each task, and how it relates to the overall project.

4.1.1 Project Planning

This task provides for management and implementation of Project Plans associated with the investigations. This includes general project management, meetings and conference calls, and preparation of a work plan. These subtasks are described in more detail below:

4.1.1.1 Project Management

Project management activities include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, personnel resources, planning and allocation, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with LANTDIV and NAS Oceana. Project management will be an ongoing task.

4.1.1.2 Meeting and Conference Calls

During the course of this investigation, meetings will be necessary to correspond and communicate issues related to the development of the work plans and field sampling activities planned at NAS Oceana. It is estimated that the Activity Manager will participate in calls with LANTDIV and the regulators over the course of the project to complete the scope of work of this CTO.

4.1.1.3 Preparation of the Work Plan

This Draft/Final Work Plan has been prepared for the facility-wide background investigation and for the localized hot spot remediation activities at SWMUs 1, 2B, and 24. This Work Plan provides for the efficient scheduling of resources such as personnel, equipment, and laboratory services. Existing reference documents included in this Work Plan include the Master Project Plans for NAB Little Creek (sample protocol/handling), and the existing Background Investigation Work Plan that has recently been completed by CH2M HILL for work completed at the Norfolk Naval Shipyard (NNSY) (rationale for sampling/locations/statistical evaluations). Referenced sections of the NAB Little Creek Master Project Plans have been included in Appendix B.

This Work Plan encompasses a broad range of anticipated activities at investigation sites and provides the background information needed to understand site conditions and the approach to be used for the site investigation and screening processes. This site-specific Work Plan includes the following:

- Site background information that focuses only on the area of investigation, rather than the entire Base, including a description of past investigations conducted at the site.
- Information concerning the site's environmental setting including the site-specific geology and topography and the water table elevation at the site.
- A map illustrating the areas of investigation in relation to the entire base.
- A description of the field investigation and activities to be performed at the site, including methods and locations of drilling and sampling and types of analyses to be performed on samples.
- A map displaying monitoring well installation and sample locations.
- A description of the tasks to be performed.
- A section explaining staff organization and task order management.
- A task order schedule.

4.2 Field Investigation

4.2.1 Field Work Support

This task consists of time spent performing field support activities and coordinating all efforts for implementation of the fieldwork, including subcontractor procurement, mobilization/demobilization, and utility clearance procedures. Appropriate planning and coordination with LANTDIV and NAS Oceana site personnel prior to mobilization in the field will be required to ensure that sampling can be conducted without interference to NAS Oceana activities. Fieldwork support includes coordination with data management personnel to ensure station and sample identifiers for each sample are accurate and appropriate for field data entry into the GIS and data management system.

4.2.1.1 Subcontractor Procurement

Activities under this subtask include procuring and administering the subcontractors needed for successful completion of the project. Budget allocation includes activities such as the preparation of technical specifications, scope, cost estimate, addressing subcontractor questions, base pass coordination and bid support. As part of the field work support, CH2M HILL will procure a total of seven different subcontractors and one supplier to complete the following tasks:

- Hollow Stem Auger Drilling and Well Installation
- Utility Clearance
- Laboratory Analysis
- Data Validation
- IDW Disposal/Handling
- Surveyor for horizontal and vertical control of monitoring wells
- Geoprobe services for injection of enhance biological reagent
- Purchase of enhanced biological reagent

The firms providing these services shall be procured using the Basic Ordering Agreements (BOAs) under the CLEAN II contract. In cases where BOAs are not in place for services required, CH2M HILL will provide subcontractor services in accordance with established procedures between CH2M HILL's contract administrator and LANTDIV's contracting officer.

4.2.1.2 Mobilization/Demobilization

Mobilization includes the procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be shipped to the environmental contractor's field team before field activities begin. Mobilization includes the time required for procurement of subcontractors, assembly, checking, calibrating, and packing of necessary field equipment, supplies, and other materials. This task includes verifying receipt of appropriate sample containers from the laboratory, preparing the containers for the field, and sample label preparation.

Demobilization activities include those necessary for the general restoration of the site prior to the return transport of field equipment and crew. Time also has been included for recalibration and storage of equipment subsequent to the field effort. It is anticipated that IDW consisting of auger cuttings, development water, and purge water will be generated during the field activities and will need to be disposed of appropriately as part of the site's demobilization activities.

4.2.1.3 Utility Clearance

Utility clearances will be performed at each site at NAS Oceana before the start of any subsurface investigation activities. CH2M HILL will coordinate subsurface utility clearances with a private utility locating company, Miss Utility, and the Public Works Center (PWC) at the Base. CH2M HILL will be responsible for ensuring that all appropriate contacts have been made with Base personnel, that clearances have been given for proposed drilling locations, and that all utilities will be marked near the areas of potential drilling prior to the initiation of field operations.

4.2.2 Well Installation

This subtask involves the installation of 13 background monitoring wells (see Figure 4-1). Proposed well locations were selected based on analysis of historical aerial photographs that exist for NAS Oceana, dating back to 1937. Proposed well locations were designated in areas that, according to the historical photographs, appeared to be non-impacted by activity over the years. Areas where construction and land development appeared to have taken place were avoided, as well as areas with apparent fill. This was done to ensure that groundwater samples collected form these wells are representative of background concentrations, non-impacted by possible surrounding contaminant sources. General assumptions concerning this effort are;

- Each monitoring well will be installed using standard hollow stem augering techniques and continuous split spoon sampling for lithologic characterization.
- Each monitoring wells will be constructed to an approximate depth of 20' bgs. The wells will be constructed of Schedule 40 PVC riser and screen. Screen lengths for each well will be 15' in length. The wells will be constructed with an appropriate clean silica pack extending two feet above the top of screen, a minimum of two feet of bentonite pellets, and the remainder of the annular space with a cement-bentonite grout extending to the surface. Each well will be equipped with a locking pressure cap and watertight flush mounted well cover, or stick-up protective casing, as appropriate.
- Each monitoring well will be developed using a submersible pump. Field measurements will be taken which will include; pH, temperature, dissolved oxygen, conductivity, turbidity, and salinity.

The applicable Standard Operating Procedures (SOPs) for the installation of monitoring wells are included with the Field Sampling Plan Checklists (Appendix A).

It is also anticipated that background monitoring well locations will be staked out and field-checked by CH2M HILL and LANTDIV/NASO personnel prior to field mobilization, in addition to discussing any current or historical land uses that were found on the historical aerial photographs that may affect well placement.

4.2.3 Groundwater Sampling

This subtask involves the sampling of 14 existing monitoring wells at the SWMUs 1, 2B, and 24 for specific organic constituents and 13 newly installed background groundwater monitoring wells for As, Fe, Mn, and Pb. Figures 3-1 through 3-3 present the existing monitoring wells to be sampled at SWMUs 1, 2B, and 24 during the initial round of sampling, respectively. Figure 4-1 shows the proposed locations for the 13 monitoring wells to be installed as part of this background investigation. General assumptions concerning this sampling effort are:

- Water-level measurements will be collected from each monitoring wells prior to purging and sampling. Water level measurements will be obtained from all monitoring wells at each SWMU to construct a groundwater flow diagram.
- Each monitoring well will be sampled using a peristaltic pump with low-flow protocol.

- Background groundwater samples will be analyzed for both total and dissolved As, Fe, Mn, and Pb from the 13 newly installed wells for initial data gathering, and then sampled again to evaluate potential seasonal variations (six months later).
- Samples collected from the 14 existing monitoring wells at SWMUs 1, 2B, and 24 will be sampled for selected parameters as presented in Table 4-1.
- Monitoring wells at SWMUs 1, 2B, and 24 where historical data indicates inorganic exceedances of the PRG for As, Fe, Mn, and Pb will be sampled during the 6-month sampling event to compare SWMU-specific concentrations to basewide values.

The applicable SOPs are presented with the Field Sampling Plan Checklist (Appendix B).

4.2.4 Mapping and Surveying

This subtask involves the efforts related to the surveying of thirteen monitoring wells for entry into the NAS Oceana GIS database and coordinating utility clearances prior to mobilizing to NAS Oceana for the installation of monitoring wells. General assumptions concerning this sampling effort are:

- The 13 newly installed monitoring wells will be surveyed by a Virginia licensed surveyor. Each well location will be surveyed for both horizontal and vertical control.
- Survey information from the 13 newly installed monitoring wells will be entered into NAS Oceana GIS database.
- Subsurface utilities will be cleared prior to mobilizing to NAS Oceana for monitoring well installation and injection of enhanced biological reagent.

The newly installed wells will be surveyed both vertically and horizontally using the Virginia State Plane Coordinate System. The vertical elevations accuracy will be ± 0.01 foot, while the horizontal location will have an accuracy of ±0.1 foot. Specifically, the elevation for each monitoring well shall be established at the top of the monitoring well's inner PVC casing (this elevation point shall be designated by a permanent notch placed on the top of each well's inner casing) and at the ground surface.

4.2.5 Investigation Derived Waste

Field investigations at NAS Oceana will result in the generation of Investigative Derived Waste (IDW). Most of the IDW will be generated during the background investigation while installing and developing the 13 monitoring wells at non-impacted areas of the base. Purge water will be generated during groundwater sampling activities.

This subtask involves the efforts related to the disposal of all investigation derived waste (IDW), including auger cuttings and development water from monitoring well installations, solutions used to decontaminate non-disposable sampling equipment, and purge water from groundwater sampling events. IDW will be containerized in 55-gallon drums, which will be stored temporarily on-site. The IDW drums will be labeled in accordance with the procedures as outlined by NAS Oceana, such that the information on the label includes container number, container contents, origin (source area including individual wells, piezometers, and soil borings), date that accumulation began and ended. When laboratory

results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C. Soil-related wastes will be analyzed for TCLP parameters. Groundwater analytical results will be used for waste characterization and disposal of purge water. Additional samples may be required by the disposal facility. Based on the results, the IDW will be disposed of off-site as hazardous or non-hazardous waste. Subcontracted services will include the characterization and disposal of IDW.

4.3 Sample Analysis and Validation

This task includes sample management of data validation of samples collected during this investigation. CH2M HILL will track sample analysis and obtain results from the laboratory. CH2M HILL will select a laboratory from the BOA list for Navy projects based upon the lowest competitive bid from at least three bidders.

4.3.1 Sample Management

CH2M HILL will be responsible for obtaining results from the laboratory and forwarding them to a data validator. This task involved efforts related to sample tracking, data management, and data loading into Endat. The labor associated with this subtask pertains to the effort required to manage the new data from the field effort and laboratory, review the laboratory submittals to ensure that all data has been received and is satisfactory, and compile the validated laboratory data into a format that can be used for final report preparation.

This effort also includes loading the results into the database and generating reports such as raw data, detect, and exceedance reports. This database effort also involves setting up the database and ensuring that all results are unique and that the database is readily integrated into a GIS. Additionally this task will include the coordination and verification that field data and laboratory data are accurate prior to entry into the database.

EPA standard methods, including Contract Laboratory Program (CLP) procedures, will be followed during sample analysis. The appropriate number of field QA/QC samples, including field blanks, equipment rinsate blanks, matrix spike and matrix spike duplicate and duplicate samples will be analyzed in addition to laboratory QA/QC samples.

All analyses will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and USEPA's Contract Laboratory Program (CLP). A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance.

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. A complete sample summary, including QA/QC sample protocols is presented in Tables 4-1 through 4-6.

4.3.2 Data Validation

This task involved efforts related to laboratory analysis of samples and data validation. Laboratory analyses of samples will be performed according to the data quality objectives (DQOs) (Appendix B). The samples will be analyzed in a fixed laboratory with full documentation using EPA-approved methods. Analyses will include the proper ratio of field QC samples recommended by Naval Facilities Engineering Service Center (NFESC) guidance.

All analyses of groundwater will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and EPS's CLP. A signed certificate of analysis will be provided with each laboratory analysis, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance.

All data collected will be validated before use by the project staff to establish background concentrations, and determine proposed treatability zones for the localized "hot spot" remediation. The data validation will be performed by an independent subcontractor, and will conform to the highest level of EPA Region III and Navy guidance. Data that should be qualified will be flagged appropriately. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, and reasonableness.

4.4 Pilot Testing/Hot Spot Remediation

4.4.1 Initial Testing

This subtask involves the sampling of the 14 monitoring wells at SWMUs 1, 2B, and 24 that have (based upon most recent groundwater sampling data) organic constituents above MCLs or PRGs. Select constituents include both volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Samples will be collected only for those identified organic compounds that exceed MCLs or PRGs based on the most recent data. These constituents are listed in detail for each SWMU in Sections 3.1 through 3.3. Samples will be collected in the same manner as the basewide background samples (see Subtask 4.2.3 "Groundwater Sampling"). Table 4-1 presents the monitoring wells from which groundwater will be collected and sent to the laboratory, and which specific organic parameters will be analyzed for each sample. In addition to the select organic constituents, the following wet chemistry parameters (Table 4-4) will be analyzed at each monitoring well: dissolved gases (methane, ethane, ethene); alkalinity; chloride, sulfate, sulfide, nitrate as nitrogen, nitrite as nitrogen, carbon dioxide, and total organic carbon (TOC).

4.4.2 Data Evaluation

This subtask involves analysis and review of the analytical results to establish concentration limits for localized "hot spot" remediation. Once "new" data are obtained, site specific organic concentrations will be compared to MCLs/PRGs, and those monitoring wells/ constituents that exceed these concentrations will be evaluated to determine an appropriate enhanced biological reagent for remediation. Data evaluation includes review of

appropriate remediation alternatives, coordinating vendor proposals, and selecting an appropriate reagent. However, if COPCs are detected below MCLs or PRGs, a "no further action" (NFA) will be recommended if the 2nd round (6-week interval) confirms the initial testing. In this case, the monitoring well would not be recommended for remediation and abandonment would be recommended following receipt and comparison of the second round sample results to MCLs and/or PRGs.

4.4.3 Site Installation

This subtask involves the field efforts associated with the injection of the selected enhanced biological reagent to complete the localized "hot spot" groundwater remediation pilot study. It is anticipated that a qualified Geoprobe subcontractor will be utilized to perform the injection at those areas demonstrating elevated organic concentrations after the initial sampling is completed, with oversight by CH2M HILL. The injection reagent will be determined based upon the results of the initial sampling event. The recommendation will be made in a Technical Memorandum (Section 4.4.5).

4.4.4 Post-Injection Testing

This subtask will be completed approximately six weeks following the injection of the biological reagent to evaluate the effectiveness of the pilot study at the localized "hot spots." Post testing will then take place three months, six months, and nine months following the injection activity. Sampling will be identical to that described in the "Initial Testing" subtask.

4.4.5 Technical Memorandum

CH2M HILL will summarize the results of the basewide background groundwater quality investigation for inorganics and the localized hot spot remediation in technical memorandums. Two technical memorandums will be prepared to summarize the results of the investigations:

- Following the initial round of hot spot and background sampling, and;
- Following the completion of the hot spot remediation.

The second technical memorandum will also include an evaluation of basewide inorganic concentrations after a second round of sampling has been collected to determine potential seasonal variations in groundwater quality. Section 6 (Project Schedule) includes a figure demonstrating when technical memorandums will be prepared and distributed.

4.4.5.1 Hot Spot Remediation

CH2M HILL will prepare a technical memorandum summarizing the results of the initial sampling event that makes specific recommendations for additional actions to be taken at specific wells to complete the localized "hot spot" groundwater pilot study/remediation. This will include a detailed analysis constituent concentrations and groundwater quality, and make specific recommendations for a reagent to be injected as part of the hot spot remediation (see Section 4.4.2). Following the completion of four rounds of post-injection monitoring, CH2M HILL will provide a second Technical Memorandum summarizing the results of the pilot study at each SWMU/monitoring well. Data will be evaluated and compared to MCLs or PRGs.

Table 4-1
Sample Parameters SWMUs 1, 2B, and 24
NAS Oceana
Virginia Beach, Virginia

SWMU	Well ID	Constituent							TOTAL ANALYTES	TOTAL SAMPLES
		VOCs					SVOCs			
		1,1-DCE	cis-1,2-DCE	Benzene	TCE	VC	bis(2-Ethyl-hexyl)Phthalate	Napthalene		
1	OW01-MW04							X	1	1
	OW01-PZ03			X					1	1
2B	OW2B-MW01		X			X			2	1
	OW2B-MW02				X				1	1
	OW2B-MW03					X			1	1
	OW2B-MW04			X			X		2	2
	OW2B-MW05					X			1	1
	OW2B-MW13					X			1	1
	OW2B-MW14					X			1	1
	OW2B-MW17	X				X			2	1
	OW2B-MW18					X			1	1
24	OW24-MW03		X		X				2	1
	OW24-MW09				X				1	1
	OW24-PZ03S		X			X			2	1

TOTAL VOCs	17	15
TOTAL SVOCs	2	
TOTAL SAMPLES	19	

Notes: DCE - Dichloroethene
TCE - Trichloroethene
VC - Vinyl Chloride

4.4.5.2 Background Investigation Report

This task involves the preparation of a Background Technical Memorandum detailing the objectives for the groundwater background investigation, field work efforts and statistical evaluation of groundwater concentrations on a basewide level for arsenic, iron, manganese, and lead at the 13 monitoring wells to be installed in the Columbia (shallow) Aquifer at NAS Oceana.

Data from each of the 13 monitoring wells will be evaluated for outlying values that might not be representative of ambient concentrations. Barring unusual spatial outliers, data from each well will be pooled and summary statistics for each analyte will be provided which will include a test for normality and the calculation of an upper tolerance limit (UTL) for use in comparing whether individual site results appear to be part of population equivalent to background. The data set will be organized to be available for alternative statistical comparisons, such as analysis of variance (ANOVA) or two sample comparisons of central tendency.

A follow-up evaluation will be conducted approximately six months after the first technical memorandum. This evaluation will be used to help identify any seasonal variations in groundwater concentrations and confirm the consistency of the initial data.

TABLE 4-2
Sample Summary
NAS Oceana—Virginia Beach, Virginia

Media	Number of Samples[a]	Analysis	Methodology
Groundwater for Background Investigation	13 per round	Total and Dissolved Arsenic, Iron, Manganese, and Lead	U.S EPA CLP Inorganics SOW ILM04 or latest version
Groundwater for Hot Spot Remediation	14 per round	VOCs and SVOCs exceeding MCLs or PRGs, Water Quality parameters	U.S. EPA CLP for Low-Concentration Water OLC02 (8/94)[b, c]

Notes:

CLP = Contract Laboratory Program (most recent version)

[a] Not including QA/QC samples

[b] The laboratory may analyze organic samples under another U.S. EPA CLP organics SOW if the reporting limits on Table 8-2 of the Master QAPP can be met and verified by MDL studies.

[c] OLC02 is not a method to use if the concentration of any of the target compounds is above 50 ug/L. For hot spot remediation, the laboratory will be given the previous results from that location, and pre-screen to determine the correct dilution to use.

Background Investigation – 2 Rounds of sampling

Hot Spot Remediation – Initial testing round, and then following the reagent injection at 6 weeks, 3 months, 6 months and 9 months. 2nd Round of Background Investigation sampling concurrent with 6 month sampling event. Only those VOCs and SVOCs exceeding MCLs or PRGs during the preceding round will be sampled for, therefore number of samples may decrease from round to round, according to sample results.

TABLE 4-3
Background Investigation Groundwater & QA/QC Samples
NAS Oceana—Virginia Beach, Virginia

Parameter	Method	No. of Samples	Trip Blanks	Equipment Rinsate Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Groundwater Samples per Round								
Total and Dissolved As, Fe, Mn, and Pb	CLP ILM04	13	0	4	1	2	1/1	22

Notes:

Number of samples are *per round* of background groundwater sampling. Two total rounds are planned (one initial round, and one concurrent with 6th - month round of Hot Spot Remediation testing).

Assumptions regarding rate of sample collection:

1. Four days are required to collect groundwater samples
2. Not sampling for VOCs, therefore no Trip Blanks needed
3. Equipment Rinsate blanks – One equipment rinsate will be collected per day
4. Field Blank – One per sampling event, and at least one per week (if very windy or dusty, collect one per day)
5. Field Duplicates – One per every ten samples per matrix/medium
6. Matrix Spike/Matrix Spike Duplicates – One each per 20 samples per matrix

TABLE 4-4
Hot Spot Remediation Groundwater & QA/QC Samples
NAS Oceana—Virginia Beach, Virginia

Parameter	Method	No. of Samples	Trip Blanks	Equipment Rinsate Blanks	Field Blanks	Field Duplicates	Matrix Spike/ Duplicate	Total Number of Samples
Groundwater Samples per Round								
TCL VOCs (Low Concentration)	CLP OLC02	14	5	5	1	2	N/A	27
TCL SVOCs (Low Concentration)	CLP OLC02	5	0	5	1	1	N/A	12
TCL Pesticides (Low Concentration)	CLP OLC03	1	0	1	1	1	N/A	4
Dissolved Gases – Methane, Ethane, and Ethene	RSK-175	14	0	0	0	1	0	15
Alkalinity	EPA 310.1	14	0	0	0	1	0	15
Chloride, Nitrate as Nitrogen; Nitrite as Nitrogen; Sulfate	IC – 300.0	14	0	0	0	1	0	15
Sulfide	MCAWW 376	14	0	0	0	1	0	15
Carbon Dioxide	RSK-175	14	0	0	0	1	0	15
TOC	SW846-9060	14	0	0	0	1	0	15
Field Measurements: pH, Temperature, Dissolved Oxygen, Redox potential, Turbidity	Field Measurements: Horiba U-22 Water Quality Meter and Field Test Kits	14	0	0	0	0	0	14

Notes:

Number of samples are *per round* of hot spot remediation groundwater sampling. Five total rounds of sampling planned (Initial, 6 weeks, 3 months, 6 months concurrent with 2nd round of background sampling, and 9 months following reagent injection. Only locations exceeding MCLs or PRGs from preceding sampling round will be sampled for, thus number of samples may decrease from round to round.

Assumptions regarding rate of sample collection:

1. Five days are required to collect groundwater samples
2. Trip blanks – one per cooler containing VOC samples, one cooler generated per day
3. Equipment Rinsate blanks – One equipment rinsate blank will be collected per day
4. Field Blanks – One per sampling event, and at least one per week (if very windy or dusty, collect one per day)
5. Field Duplicates – One per every ten samples per matrix/medium
6. Matrix Spike/Matrix Spike Duplicates – One each per 20 samples per matrix (not required for low-concentration analyses by CLP OLC02)

TABLE 4-5
Required Containers, Preservatives, and Holding Times for All Groundwater Samples
NAS Oceana—Virginia Beach, Virginia

Parameter	Method	No. of Sample Containers	Sample Containers	Preservative	Holding Time	Volume of Sample Collected
Groundwater Samples						
Total and Dissolved As, Fe, Mn, and Pb	CLP ILM04	1	1-liter polyethylene bottle	HNO_3 to pH<2; Cool to 4°C	6 Months	Fill to shoulder
TCL VOCs (Low Concentration)	CLP OLC02	3	40 mL glass vials w/ Teflon-lined cap	HCL to pH<2; Cool to 4°C	14 Days	Fill completely; no air bubbles
TCL SVOCs (Low Concentration)	CLP OLC02	2	1-liter amber glass bottle	Cool to 4°C	7 Days	Fill to shoulder
TCL Pesticides (Low Concentration)	CLP OLC03	2	1-liter amber glass bottle	Cool to 4°C	7 Days	Fill to shoulder
Dissolved Gases – Methane, Ethane, and Ethene	RSK-175	2	40 mL glass vials w/ Teflon-lined cap	HCL to pH<2; Cool to 4°C	7 days	Fill completely; no air bubbles
Alkalinity	EPA 310.1	1	250 mL plastic bottle	Cool to 4°C	14 Days	Fill to shoulder
Chloride; Nitrate as Nitrogen; Nitrite as Nitrogen; Sulfate	IC – 300.0	1	250 mL plastic bottle	Cool to 4°C	48 Hours	Fill to shoulder
Sulfide	MCAWW 376	1	500 mL plastic bottle	Zinc Acetate; Cool to 4°C	7 Days	Fill to shoulder
Carbon Dioxide	RSK-175	2	40 mL glass vials w/ Teflon-lined cap	Cool to 4°C	24 Hours	Fill to shoulder
TOC	SW846-9060	1	500 mL amber glass bottle	H_2SO_4 or HNO_3 to pH<2; Cool to 4°C	28 Days	Fill completely; no air bubbles

TABLE 4-6
Analytical Data Electronic Deliverable

Field Name	Field Format	Req'd	Description
Sample_ID	A25	R	CH2M HILL sample ID (taken from the chain of custody).
Analysis_Group *	A9	R	The CH2M HILL code for the analysis performed on the sample.
DateTime_Collected	00/00/0000 00:00:00	R	The date the sample was collected (from the chain of custody). Use 24-hour clock
Date_Received	00/00/0000	R	The date the sample was received in the lab.
Date_Extracted	00/00/0000	RA	Extraction or preparation date.
Date_Analyzed	00/00/0000	R	The date the sample was analyzed.
Lab_Sample_ID	A15	R	The laboratory sample ID.
Dilution_Factor	N5	R	The dilution factor used. Use 1 if not diluted.
SDG_Number	A15	R	Laboratory code for the group of samples in a data deliverable package.
Chem_Code	A12	R	The ERPIMS parameter code.
Chem_Name *	A45	R	The compound being analyzed.
CAS_Number *	A6-A2-A1	R	CAS Number (Note dashes).
Ana_Value	N11	R	The analytical result. It should match the number of significant digits on the hard copy. Use detection limit when not detected.
Lab_Qual *	A5	RA	The lab qualifiers, if any (e.g., U, UJ, B); there may be a qualifier not on the valid value table in special cases.
DV_Qual	A5		Left blank for data validation qualifiers.
DV_Qual_Code*	A5		Left blank for data validation qualifier codes. Use valid values.
Units *	A15	R	The unit of the result (e.g., mg/L).
Detect_Limit	N5	R	The minimum available sample-specific detection limit for the compound, the laboratory reporting limit.
MDL	N10.3	R	Method detection limit.
Preparation	A15	R	ERPIMS code used for the preparation method of the sample fraction.
Analysis_Method	A15	R	Analytical method used to analyze the sample fraction. Use ERPIMS codes.
Result_Type *	A15	RA	The laboratory QC type for single compounds (e.g, SURR, IS) All surrogates and internal standard results are to be reported in % recovery units.
Lab_QC_Type *	A15	RA	Laboratory samples (lab blanks, dups, LCS, etc.).
PCT_Moisture	N3,3	RA	Percent moisture for soil samples; not applicable for aqueous samples.
Basis	A3	RA	Concentrations are reported on a wet or dry weight basis. Use ERPIMS codes.
Batch	A12	R	Laboratory code for the batch of samples analyzed together.
Lab_Code	A10	R	The ERPIMS code for the name of the laboratory.
ReRun*	A9	RA	To report dilutions, re-extractions, and/or re-analyses.
QC_Limits	AAA-AAA	RA	Laboratory QC limits in percent recovery for surrogates, internal standards, laboratory control spikes, calibration checks, interference check standards, serial dilutions, and MS/MSDs.
Comment	A 30	RA	For the laboratory to note exceptions.

Notes:
* - See valid value list
TICs are not reported on the EDD
R - Required field
NR - Not Required
RA - Required as Appropriate
EDD may be submitted in ASCII (comma delimited) or in Excel

File Path: v:\18gis\oceana\figures\new_oceana_0100.apr

LEGEND

- Monitoring Well Locations
- SWMU Boundaries
- Buildings
- Roads
- Runways
- Activity Boundary Line

N

0 2000 4000 Feet

Figure 4-1
Inorganic Background Monitoring Well Locations
Basewide Background Investigation Work Plan
NAS Oceana
Virginia Beach, Virginia

CH2MHILL

00632A04y

5 Project Management and Staffing

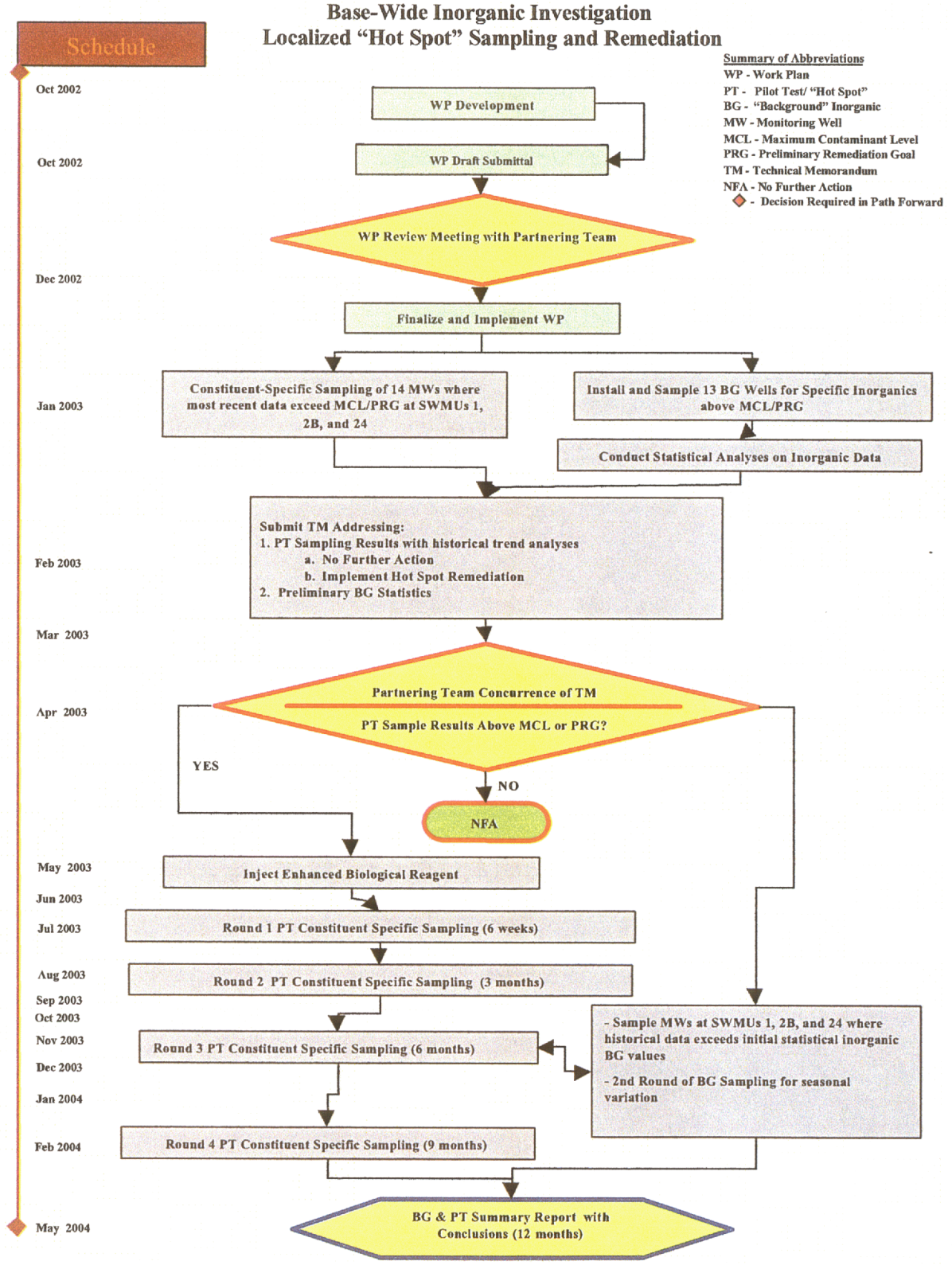
The CH2M HILL Activity Manger and Project Manager designated for this project is Mr. Paul Landin. Mr. Landin will assume primary responsibility for ensuring that the work is performed in a manner that is acceptable to LANTDIV, the activity, and the government regulatory agencies. Ms. Jayanti Sachdev will provide assistance at the activity level as necessary. Mr. Landin will be responsible for budget and schedule oversight. As project manager, he will be responsible for such activities as technical support and oversight, budget and schedule review and tracking, review of invoices, personnel resources planning and allocation, and coordination with LANTDIV, NAS Oceana, and subcontractors.

Mr. Doug Dronfield will provide senior review of hydrogeological issues. Mr. Gary Hickman will provide senior review for the localized "hot spot" groundwater remediation and treatability study work plan. Mr. Larry Hilscher (P3 Statistician) will perform the statistical analyses on the background inorganic monitoring well data. Ms. Jamie Culbreth will serve as the EIS for sample data. Mr. Brian Anderson (T3 Graphics Technician) will serve as the GIS lead. Mr. Dan Holloway, Ms. Erica Mathews, or Mr. Stacin Martin will serve as the field team leader during field efforts. CH2M HILL will notify LANTDIV and NAS Oceana regarding which CH2M HILL personnel will mobilize to the sites prior to initiating field activities.

6 Project Schedule

Figure 6-1 shows a breakdown of the project schedule for field activities and primary deliverables, including assumed intervals for regulatory review.

Figure 6-1
Decision Process Flow Diagram
NAS Oceana Work Plan
Base-Wide Inorganic Investigation
Localized "Hot Spot" Sampling and Remediation



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Appendix A
Site Specific Health and Safety Plan

CH2M HILL HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP HS-19, *Site-Specific Written Safety Plans*)

This Health and Safety Plan will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign Attachment 1.

Project Information and Description

PROJECT NO:	175094
CLIENT:	Department of the Navy, Atlantic Division
PROJECT/SITE:	Oceana Naval Air Station
SITE ADDRESS:	Oceana Boulevard Virginia Beach, VA 23455
CH2M HILL PROJECT MANAGER:	Paul A. Landin/VBO
CH2M HILL OFFICE:	5700 Thurston Ave. Suite 120 Virginia Beach, VA 23455
DATE HEALTH & SAFETY PLAN PREPARED:	October 2, 2002
DATE(S) OF SITE WORK:	December 2002
SITE ACCESS:	The site is accessed through a secured gate located on Oceana Boulevard.
SITE SIZE:	NAS Oceana encompasses approximately 6,000 acres in the eastern central portion of Virginia Beach, Virginia
SITE TOPOGRAPHY:	The topography of the Oceana Naval Air Station is flat. The ground surface elevation ranges from a high of approximately 25 feet above mean sea level (msl) in the eastern portion of the facility to just above msl along the bulkhead adjacent to the Chesapeake Bay.
PREVAILING WEATHER:	The Virginia Beach region has a maritime climate that is characterized by long, temperate summers and mild winters.

SITE DESCRIPTION AND HISTORY:

Oceana Naval Air Station began as a small auxiliary air field constructed by the U.S. Government on 328 acres of remote, swampy land in November 1940. The original air station consisted of two 500 foot long asphalt and a workforce of 32 officers and 172 enlisted personnel. In 1943, at the height of the Second World War, Congress approved plans to expand the station to accommodate 160 officers and 800 enlisted personnel. Oceana was designated a Naval Air Station in the late 1950's when it became too large to work as a subordinate to other stations in the area. Oceana then became an all weather station, and was eventually designated a Master Jet Base.

Over the years, Oceana has grown to more than 16 times its origonal size. The base presently encompasses 5,916 arces and supports a naval community of more than 10,200 Navy personnel and some 11,500 dependents. The annual payroll exceeds $286 million.

The twelve (12) F-14 Tomcat jet-fighter squadrons and the seven (7) A-6 Intruder medium-attack squadrons assigned to the Atlantic Fleet are based at Oceana. In addition, the station also supports a search and rescue unit and three (3) squadrons of training aircrews and maintenance personnel.

Description of Tasks:

Installation and sampling of 13 monitoring wells at non-impacted locations to establish background concentrations of Arsenic (As), Iron (Fe), Maganese (Mn), and Lead (Pb).

Sampling and analysis of specific organic constituents that exceed Maximum Contaminant Levels (MCLs) or calculated human health-based Preliminary Remediation Goals (PRG's) at individual monitoring wells at SWMUs 1, 2B, 2E, and 24. The data evaluation will be used to develop and compare potential in-situ "hot-spot" remediation alternatives at 19 monitoring wells.

Site Map

This page is reserved for a Site Map.

See Figure 1-1 in Work Plan

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1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

The field investigation at the Oceana Naval Air Station will include monitoring well installation and groundwater sampling. Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for the task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin.

1.1.1 Hazwoper-Regulated Tasks

- Ground water sampling in "Hot Spot" wells contaminated with organic constiuents. (SWMU 1, 2B, 2E, and 24)
- Bio re-agent injection

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

- Drilling and Monitoring Well installation at non-impacted locations.
- Groundwater sampling at non-impacted locations

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIALHAZARDS	TASKS		
	Drilling & installation of monitoring wells. Geoprobe injection of Bio- reagent.	Groundwater Sampling	Investigation Derived Waste disposal
Flying debris/objects	X		X
Noise > 85dBA	X		
Thermal Stress	X		
Suspended loads	X		
Buried utilities, drums, tanks	X		
Slip, trip, fall	X	X	X
Back injury	X	X	X
Visible lightning	X	X	X
Fires	X		
Entanglement	X		
Drilling	X		
Heavy equipment	X		

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 5. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Prior to each field event involving the use of a Drill Rig or Direct Push Technology.**

2.1 Project-Specific Physical (Safety) Hazards

2.1.1 Drilling

(Reference CH2M HILL SOP HS-35, *Drilling*)

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.

2.1.2 IDW Drum Sampling

Personnel are permitted to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.
- PPE and air monitoring requirements specified in Sections 4 and 5 must address IDW drum sampling.
- Spill-containment procedures specified in Section 7 must be appropriate for the material to be handled.

2.2 General Hazards

2.2.1 General Hazards and Housekeeping

(Reference CH2M HILL SOP HS-20, *General Practices*)

- Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity to read a newspaper without difficulty.
- Hearing protection must be worn in areas where you need to shout to hear someone within 3 feet.
- Good housekeeping must be maintained at all times in all project work areas.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-05, *Hazard Communication)*

The SSC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Manual Lifting

(Reference CH2M HILL SOP HS-29, *Manual Lifting*)

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift -- especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-22, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. Fire extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Heat Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

Preventing and Treating Heat Stress

- Drink 16 ounces of water before beginning work.
  - Disposal cups and water maintained at 50°F to 60°F should be available.
  - Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day.
  - Do not use alcohol in place of water or other nonalcoholic fluids.
  - Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads .
- Take regular breaks in a cool, shaded area.
- Use cooling devices, such as cooling vests, to aid natural body ventilation
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Provide adequate shelter/shade to protect personnel against radiant heat.
- Maintain good hygiene standards by frequently changing clothing and showering.
- Monitor buddy for signs of heat stress. Persons who experience signs of heat rash or heat cramps should consult the SSC to avoid progression of heat-related illness.
- Those who experience heat syncope (sudden fainting), heat exhaustion (hot, pale, clammy/moist skin), or heat stroke (red, hot, dry skin; loss of consciousness) must be cooled down immediately and provided cool water or sports drink. Persons who experience heat syncope or heat exhaustion should also seek medical attention as soon as possible. Persons who experience heat stroke must get immediate medical attention.

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.7 Preventing and Treating Cold Stress

(Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and ***wear proper clothing for the anticipated fieldwork.***
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC) (CH2M HILL SOP HS-09).
- ***Wind-Chill Index*** is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it is used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- ***NSC Guidelines for Work and Warm-Up Schedules*** can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; ***workers should be monitored for symptoms of cold-related illnesses***. If symptoms are not observed, the work duration can be increased.
- Persons who experience signs of incipient frost bite (frost nip) or incipient hypothermia (generally cold, shivering) should consult the SSC to avoid progression of cold-related illness.
- Persons who experience signs of frost bite (discolored, waxy, resilient skin) or hypothermia (low body temperature characterized by uncontrollable shivering, weakness, apathy, etc.) must be warmed and provided warm fluids (not hot, and no caffeinated drinks), and must get immediate medical attention.

2.2.8 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: **Public Works Department- Oceana Naval Air Station**
Phone: **(757)433-3105**

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

2.3 Biological Hazards and Controls

(Reference CH2M HILL SOP HS-46, *Biological Hazards)*

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.3.3 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.4 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.4 Radiological Hazards and Controls

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual,* and *Corporate Health and Safety Program, Radiation Protection Program Manual*, for standards of practice in contaminated areas.

Hazards	Controls
None Known	None Required

2.5 Contaminants of Concern (Refer to Project Files for more detailed contaminant information)

Contaminant	Maximum Concentration and location	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Arsenic	GW: UK New Well	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Benzene	GW: SWMU 1- PZ03 SWMU 2E- MW17 SWM 2E- MW04	1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Benzo(a)anthracene	GW: SWMU 2E- MW08	0.2 mg/m^3	Ca	Known carcinogen in animals. Probable carcinogen to humans	UK
Bis- (2-ethylhexyl) phthalate	GW: SWMU 2B- MW04 SWMU 2E- MW04	5 mg/m^3	5,000 Ca	Eye and mucous membrane irritant	UK
1,1-Dichloroethane	GW: SWMU 2B- MW17	100 ppm	3,000	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
Cis-1,2-Dichloroethene	GW: SWMU 2B- MW01 SWMU 24- MW03 SWMU 24- PZ03S	200 ppm	1000	Eyes and respiratory system irritant. CNS depres.	9.65
Iron	GW: UK New Wells	5 mg/m^3	2500 mg/m^3	Begign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis).	NA
Lead	GW: UK New Wells	0.05 mg/m^3	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Manganese	GW: UK New Wells	1 mg/m^3	500 mg/m^3	Parkinson's; Asthenia, insomnia, mental confusion; Metal fume fever; Dry throat, cough, tight chest, dyspnea (breathing difficulty), rales, flu like fever; Low back pain; vomit; Malaise (vague feeling of discomfort), fatigue; Kidney damage	NA
2-methylnaphthalene	GW: SWMU 2E- MW01 SWMU 2E- MW04 SWMU 2E- MW08	OSHA 10ppm (50 mg/m^3)	250 ppm	Irritation to the eyes; headache, confusion, excitement, malaise; Nausea, vomit, abdominal pain, irritation of the bladder; Profuse sweating; Jaundice; Hemaglobinuria, renal shutdown, dermatitis, optical neuritis, cornea damage.	8.12
Naphthalene	GW: SWMU 1- MW04	10 ppm	250	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
Pyrene	GW: SWMU-MW08	0.2 mg/m^3	Ca	Prolonged exposure to pyrene leads to reproductive system toxicity and bone marrow toxicity. Probable human carcinogen.	UK

2.5 Contaminants of Concern (Refer to Project Files for more detailed contaminant information)

Contaminant	Maximum Concentration and location	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Trichloroethylene (TCE)	GW: SWMU 2B- MW02 SWMU 24- MW03 SWMU 24-MW09	50 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Vinyl Chloride	GW: SWMU 2B- MW01 SWMU 2B- MW03 SWMU 2B- MW05 SWMU 2B- MW13 SWMU 2B- MW14 SWMU 2B-MW 17 SWMU 2B-MW 18 SWMU 2E-MW 09 SWMU 24- PZ03S	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinalbleeding, enlarged liver, pallor or cyanosis of extremities	9.99

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, REL, or TLV listed.

[c] IDLH = immediately dangerous to life and health; NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Contaminated particulates. This route of exposure is considered to be minimal due to the fact that type of work performed which does not create a dusty atmosphere, and the absence of adjoining work that may create a dusty atmosphere.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-01, *Medical Surveillance,* and HS-02, *Health and Safety Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Paul Landin	VBO	Project Manager	Level C SSC; FA -CPR
Erica Mathews	VBO	Field Team Leader/SSC	Level C SSC; FA-CPR
Dan Halloway	VBO	Field Team Member	Level C SSC; FA-CPR
Stacin Martin	VBO	Field Team Member	Level C SSC; FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name: **Mr. Tim Reisch/Navy Technical Representative LANTNAFACENGCON**
Phone: **(757)322-4758**
Facility Contact Name: **Mr. John Ballinger**
Phone: **(757)433-3443**

3.2.2 CH2M HILL

Project Manager: **Paul Landin/VBO**
Health and Safety Manager: **Steve Beck/MKE**
Field Team Leader/SSC: **Erica Mathews/VBO**

The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Subcontractor: **TBD** Subcontractor Contact Name: **TBD** Telephone: **TBD** Subcontractor Task: **Drilling & Well Installation**	Subcontractor: **TBD** Subcontractor Contact Name: **TBD** Telephone: **TBD** Subcontractor Task: **IDW Disposal/Handling**
Subcontractor: **TBD** Subcontractor Contact Name: **TBD** Telephone: **TBD** Subcontractor Task: **Surveyor**	Subcontractor: **TBD** Subcontractor Contact Name: **TBD** Telephone: **TBD** Subcontractor Task: **Geoprobe & Bio-reagent**
Subcontractor: **TBD** Subcontractor Contact Name: **TBD** Telephone: **TBD** Subcontractor Task: **Utility Clearance**	

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 6 are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other record

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
• General site entry • Utility Location • Surveying • Observation of material loading for offsite disposal.	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Drilling and Monitoring Well installation in "non-impacted" locations. • Groundwater sampling from "non-impacted locations."	Modified D	Work clothes or cotton coveralls **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Groundwater sampling from "Hot Spot" locations (SWMU1, SWMU 2B, SWMU 2E, SWMU 24) • Soil boring & Bio-reagent usage • Investigation-derived waste (drum) sampling and disposal	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
• Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

Upgrade [c]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)–then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-06, *Air Monitoring)*

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	• Groundwater Sampling at SWMU 1, SWMU 2B & SWMU 2E	Up to 1 ppm→ 1-5 ppm → 5-10 ppm → > 10ppm →	Level D Level D; Collect both Benzene and Vinyl Chloride tube; action levels not exceeded. Level C Level B (Not Authorized)	Initially and periodically during task	Daily
Dust Monitor: Visual	• Drilling	Visual dust→	Initiate dust suppression (i.e. water, mist or fans)	Initially and periodically during tasks	Not applicable
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	• Groundwater Sampling at SWMU 1, SWMU 2B & SWMU 2E	<0.5 ppm → 0.5-1 ppm → >1 ppm →	Level D Level C Level B (Not Authorized)	Initially and periodically when PID/FIB >1 ppm	Not applicable
Colormetric Tube: Drager vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent	• Groundwater Sampling at SWMU 2B & SWMU 2E	<0.5 ppm → 0.5 ppm →	Level D Level B (Not Authorized)	Initially and periodically when PID >1 ppm	Not applicable
Nose-Level Monitor[e]: Voice	• Drilling • Geoprobe	Must raise voice communicate →	Hearing protection required Stop; re-evaluate	Initially and periodically during task	Not applicable

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.
[e] Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing

6 Decontamination

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Body-suit removal
- Glove removal
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

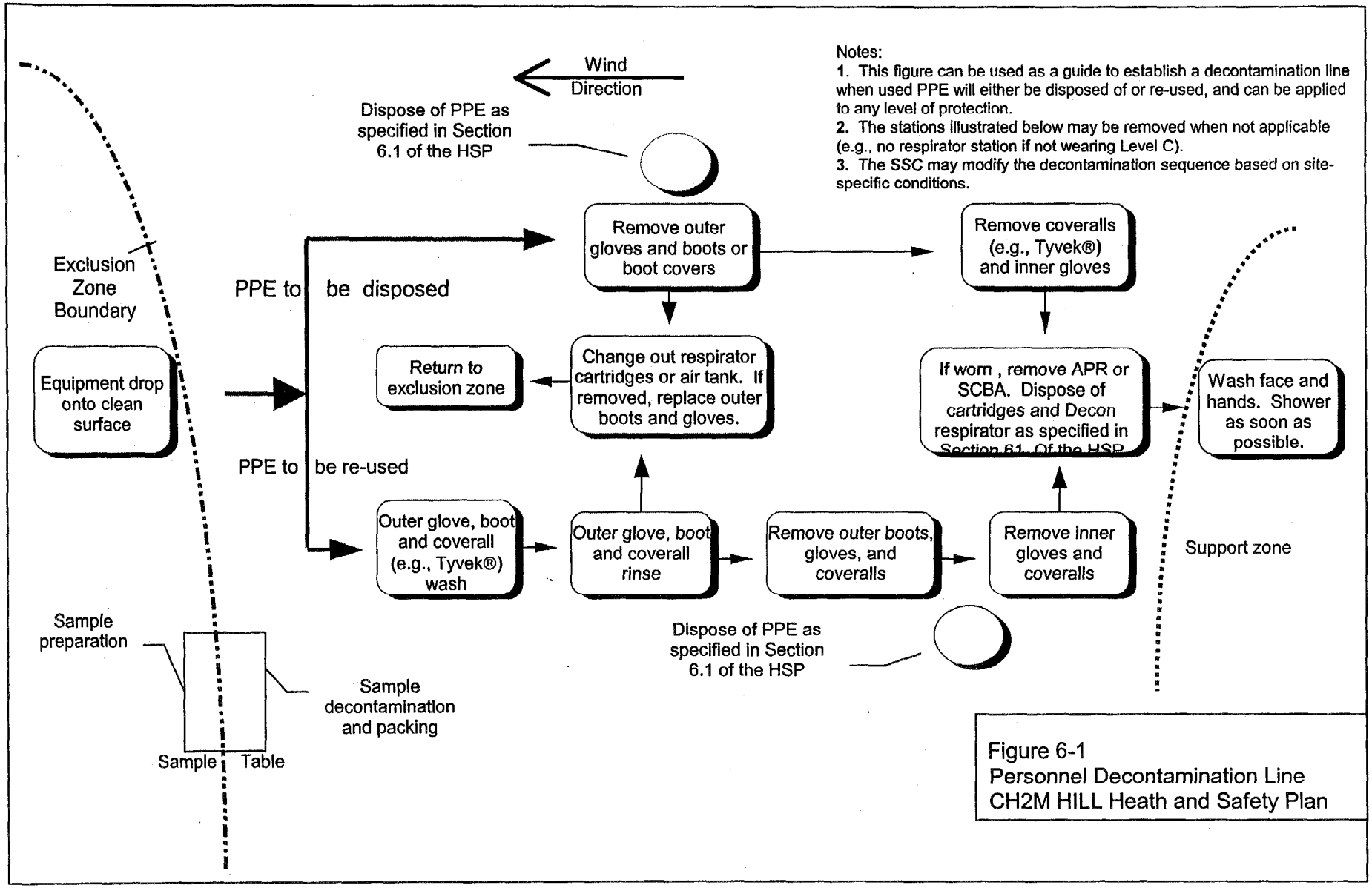


Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

7 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

8 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-11, *Site Control)*

- The SSC will review the Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies prior to work commencement.
- The SSC shall establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- The SSC shall establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- The SSC Shall establish offsite communication.
- The SSC shall ensure that a "buddy system" is maintained at all times in which field work is being conducted.
- Initial air monitoring is conducted by the SSC in appropriate level of protection.
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.

- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9 Emergency Response Plan

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

9.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.

The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
First aid kit	Field Vehicle
Eye Wash	Field Vehicle
Potable water	Field Vehicle
Bloodborne-pathogen kit	Field Vehicle
Cellular phone	Field Vehicle

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 9.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 9.7.

9.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

9.8 Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911
Facility Medical Response #: (757)433-9111
Local Ambulance #: 911

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry H. Berke, M.D., M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350

1-781-938-4653 or 1-800-350-4511
(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency – 911
Facility Fire Response #: (757)433-9111
Local Fire Dept #: 911

Corporate Health & Safety Director
Name: Dave Waite/SEA
Phone: 425/453-5000
24-hour emergency beeper: 888-444-1226

Security & Police – 911
Facility Security #: (757)433-9111
Local Police #: 911

Regional Health & Safety Program Manager
Name: John Longo/NJO
Phone: 973-316-0159
Mobile: 973-449-3587

Utilities Emergency
Water: (757)433-3105
Gas: (757)433-3105
Electric: (757)433-3105

Health and Safety Manager (HSM)
Name: Steve Beck/MKE
Phone: 414-272-2426 ext. 277

Site Safety Coordinator (SSC)
Name: Erica Mathews/VBO
Phone: (757)460-3734 ext.43

Regional Human Resources Department
Name: Cindy Bauder/WDC
Phone: 703-471-1441 ext. 4243

Project Manager
Name: Paul Landin/VBO
Phone: (757) 460 – 3734, x12

Corporate Human Resources Department
Name: Pete Hannon/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355
CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation
Contact the Regional Human Resources Dept. to have an Incident Report Form (IRF) completed. Contact ***Julie Zimmerman @ 303-664-3304*** after hours.

Auto Claims
Rental: Carol Dietz /COR 303/713-2757
CH2MHILL owned: Zurich Insurance Company 1-800/987-3373

Federal Agency / Contact Name: US EPA/ Robert Stroud **Phone:** (215)814-3366

State Agency / Contact Name: Virginia DEQ/ Steve Mihalko **Phone:** (804)698-4202

Facility Alarms: Sound Horn of Field Vehicle (3x)

Evacuation Assembly Area(s): Field Vehicle

Facility/Site Evacuation Route(s): TBD

Hospital

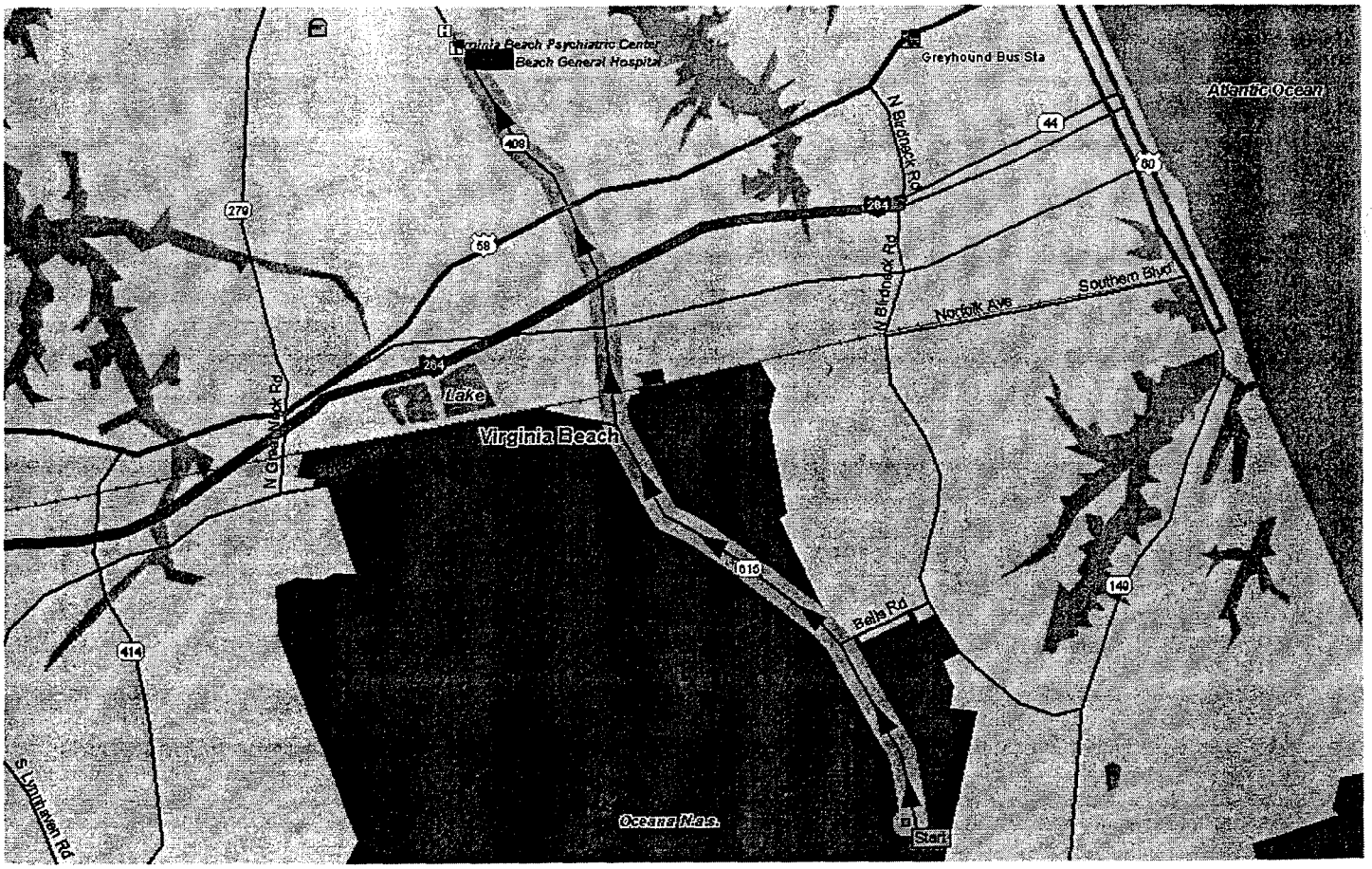
Hospital Name/Address: Virginia Beach General Hospital
1060 First Colonial Road
Virginia Beach, VA 23454

Hospital Phone #: (757)395-8000

Directions to Hospital

Route to Hospital: (Refer to Figure 1).

1) From Site- Leave base from main entrance and turn left on Oceana Boulevard.
2) Travel 3 miles, turn left on Virginia Beach Boulevard, then right on First Colonial Road.
3) Travel 1.5 Miles, Virginia Beach General Hospital is on the right.



10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Paul Landin/VBO Date: 10/2/02

Approved By: Steve Beck/MKE Date: 10/15/02

Steven J. Beck

10.2 Revisions

Revisions Made By:_____ Date: _____

Revisions to Plan:

Revisions Approved By:_____ Date: _____

11 Attachments

Attachment 1: **Employee Signoff Form – Health and Safety Plan**

Attachment 2: **Project-Specific Chemical Product Hazard Communication Form**

Attachment 3: **Chemical Specific Training Form**

Attachment 4: **Self-Assessment Checklist**

Attachment 5: **Material Safety Data Sheets (MSDS's)**

EMPLOYEE SIGNOFF FORM

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this FSI, have read and understood it, and agree to abide by its provisions.

Project Name: Oceana, "Hot Spot" Groundwater Remediation Pilot Testing **Project Number:** 175094

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

CH2MHILL

HEALTH AND SAFETY PLAN
ATTACHMENT 2

PROJECT-SPECIFIC CHEMICAL PRODUCT HAZARD COMMUNICATION FORM

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: Oceana "Hot Spot" Groundwater Remediation Pilot Testing

Project Number: 175094

MSDSs will be maintained at the following location(s): Field support vehicles

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Alconox/Liquinox	< 1liter	Support/Decon Zones			
Nitric acid	< 500 ml	Support Zone / sample bottles			
HCL	< 500 ml	Support Zone / sample bottles			
Isobutylene	1 liter, compressed	Support Zone			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

CHEMICAL-SPECIFIC TRAINING FORM

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2MHILL

HEALTH AND SAFETY PLAN

ATTACHMENT 4

SELF-ASSESMENT CHECKLISTS

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

SECTION 1 - SAFE WORK PRACTICES (4.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (4.2)

FORMS/PERMITS (4.2.1)

8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐

UTILITY LOCATING (4.2.2)

12. Location of underground utilities and structures identified	☐	☐	☐	☐

SECTION 2 (Continued)

	Yes	No	N/A	N/O
WASTE MANAGEMENT (4.2.3)				
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan	☐	☐	☐	☐
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)				
16. OE plan prepared and approved	☐	☐	☐	☐
17. OE/UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐
SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)				
GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

SECTION 4

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL
HEALTH AND SAFETY PLAN
ATTACHMENT 5

MATERIAL SAFETY DATA SHEETS (MSDS's)

ALCONOX

ALCONOX®

1. Product Identification

Synonyms: Proprietary blend of sodium linear alkylaryl sulfonate, alcohol sulfate, phosphates, and carbonates.
CAS No.: Not applicable.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes: A461

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Alconox®	N/A	90 - 100%	Yes
proprietary detergent mixture			

3. Hazards Identification

Emergency Overview

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract. Symptoms may include coughing and shortness of breath.
Ingestion:
May cause irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea.
Skin Contact:
No adverse effects expected.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:
No information found.
Fire Extinguishing Media:
Dry chemical, foam, water or carbon dioxide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. When mixed with water, material foams profusely. Small amounts of residue may be flushed to sewer with plenty of water.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Moisture may cause material to cake. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
15 mg/m3 total dust, 5 mg/m3 respirable fraction for nuisance dusts.
- ACGIH Threshold Limit Value (TLV):
10 mg/m3 total dust containing no asbestos and < 1% crystalline silica for Particulates Not Otherwise Classified (PNOC).

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White powder interspersed with cream colored flakes.
Odor:
No information found.
Solubility:
Moderate (1-10%)
Specific Gravity:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No information found.
Conditions to Avoid:
No information found.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Alconox®	No	No	None
proprietary detergent mixture			

12. Ecological Information

Environmental Fate:
This product is biodegradable.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Alconox®	Yes	No	No	No
proprietary detergent mixture				

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Alconox®	No	No	Yes	No
proprietary detergent mixture				

--------\Federal, State & International Regulations - Part 1\----------

-SARA 302- ------SARA 313------

Ingredient	RQ	TPQ	List	Chemical Catg.
Alconox® proprietary detergent mixture	No	No	No	No

\Federal, State & International Regulations - Part 2\

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Alconox® proprietary detergent mixture	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **0** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes.
Keep container closed.
Use with adequate ventilation.
Avoid breathing dust.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

NITRIC ACID

SPEX INDUSTRIES INC -- NITRIC ACID BLANK, PLBLK-HN03 -- 6850-00N020537

==========
MSDS Safety Information
==========
FSC: 6850
MSDS Date: 03/04/1988
MSDS Num: BLRMY
LIIN: 00N020537
Tech Review: 08/02/1995
Product ID: NITRIC ACID BLANK, PLBLK-HN03
Responsible Party
Cage: 07977
Name: SPEX INDUSTRIES INC
Address: 3880 PARK AVENUE
City: EDISON NJ 08820 US
Info Phone Number: 201-549-7144
Emergency Phone Number: 201-549-7144
Preparer's Name: LINDA OLCHVARY
Review Ind: N
==========
Contractor Summary
==========
Cage: 07977
Name: SPEX CERTIPREP INC
Address: 203 NORCROSS AVE
City: METUCHEN NJ 08840 US
Phone: 732-549-7144
==========
Ingredients
==========
Cas: 7697-37-2
RTECS #: QU5775000
Name: NITRIC ACID (SARA III)
% by Wt: 5
OSHA PEL: 2 PPM/4 STEL
ACGIH TLV: 2 PPM/4 STEL; 9192
EPA Rpt Qty: 1000 LBS
DOT Rpt Qty: 1000 LBS
Ozone Depleting Chemical: N
==========
Health Hazards Data
==========
LD50 LC50 Mixture: LC50:(INHALE/RAT) 224 PPM(NO2)/30M
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: YES
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: CONC NITRIC ACID MAY BE FATAL IF TOO MUCH IS INHALED/ABSORBED THRU SKIN.CONC NITRIC ACID VAP/MIST IS IRRITANT OF EYES, MUC MEMB & SKIN.IN CONT W/EYES, PRODUCES SEVERE BURNS WHICH MAY RESULT IN PERMANE NT DMG & VISUAL IMPAIRMENT.ON SKIN, LIQ/CONC VAP PRODUCES IMMED, SEVERE & PENETRATING BURNS; CONC (SEE EFTS OF OVEREXP)
Explanation Of Carcinogenicity: NOT RELEVANT
Signs And Symptions Of Overexposure: HLTH HAZ:SOLN CAUSES DEEP ULCERS & STAINS SKIN BRIGHT YELLOW/YELLOWISH BROWN COLOR.VAP & MIST MAY ERODE EXPSD TEETH W/PRLNGD EXPOS.INGEST OF LIQ WILL CAUSE IMMED PAIN & BURNS OF MOUTH, ESOPHAGUS & GI TRACT.INHAL MAY BE FATAL CAUSING SPASM,INFLAM & EDEMA OF LARYNX & BRONCHI, CHEM PNEUM & PULM EDEMA. SYMP (SUPP DATA)
Medical Cond Aggravated By Exposure: NONE SPECIFIED BY MANUFACTURER.

First Aid: EYES: FLUSH WITH WATER FOR AT LEAST 15 MINUTES OCCASIONALLY LIFTING UPPER AND LOWER EYELIDS. SKIN: REMOVE CONTAMINATED CLOTHING, THEN FLUSH WITH WATER FOR AT LEAST 15 MINUTES. WASH CLOTHING THOROUGHLY BEFORE REUSE. INHAL: MOVE TO FRESH AIR. IF IRRITATION CONTINUES, CALL MD IMMEDIATELY. INGEST: CALL MD IMMEDIATELY (FP N).

==========

Handling and Disposal

==========

Spill Release Procedures: VENT AREA. DILUTE SPILL W/WATER & NEUT W/ SODA ASH, LIMESTONE, ETC. WIPE UP & PUT IN A SEALED CNTNR FOR PROPER DISP. WASH SPILL SITE OFF W/WATER AFTER MATL PICK UP IS COMPLETE. WEAR CHEM RESISTANT GLA SSES, GLOVES & CLTHG. WEAR NIOSH/MSHA APPRVD RESP.

Neutralizing Agent: SEE SPILL/RELEASE PROCEDURES.

Waste Disposal Methods: CONTACT LOCAL HAZARDOUS OR CHEMICAL WASTE DISPOSAL AGENCY FOR REGULATIONS. DISPOSAL MUST BE IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS (FP N).

Handling And Storage Precautions: CONCENTRATED NITRIC ACID WILL ATTACK SOME FORMS OF PLASTICS, RUBBER AND COATINGS. STORE AT ROOM TEMPERATURE. KEEP TIGHTLY SEALED WHEN NOT IN USE.

Other Precautions: HAVE IMMEDIATE AVAILABILITY OF AN EYE WASH IN CASE OF EMERGENCY. AVOID INHALATION, INGESTION AND CONTACT WITH EYES AND SKIN.

==========

Fire and Explosion Hazard Information

==========

Flash Point Text: NOT COMBUSTIBLE

Extinguishing Media: APPROPRIATE TO SURROUNDING FIRE CONDITIONS.

Fire Fighting Procedures: WEAR NIOSH/MSHA APPRVD SCBA & FULL PROT EQUIP (FP N). CONC HNO3 REACTS EXPLO W/COMBUST ORG/READILY OXIDIZABLE MATLS SUCH AS; ALCOHOL, WOOD, (SEE SUPP DATA)

Unusual Fire/Explosion Hazard: CONC HNO3 IS NOT COMBUST, BUT IS STRONG OXIDIZER & ITS HEAT OF RXN W/REDUCING AGENTS/COMBUST MAY CAUSE IGNIT. CAN REACT W/METALS TO RELEASE FLAM HYDROGEN GAS.

==========

Control Measures

==========

Respiratory Protection: NIOSH/MSHA APPROVED RESPIRATOR.

Ventilation: USE IN A CHEMICAL FUME HOOD.

Protective Gloves: CHEMICAL RESISTANT GLOVES.

Eye Protection: CHEM WORK GOGG/FULL LENGTH FACESHLD(FPN)

Other Protective Equipment: CHEMICAL RESISTANT CLOTHING. EYE WASH IN CASE OF EMERGENCY AND A LAB COAT. DELUGE SHOWER (FP N).

Work Hygienic Practices: WASH CAREFULLY AFTER USE.

Supplemental Safety and Health: FIRE FIGHT PROC:TURPENTINE/METAL POWDERS/ HYDROGEN SULFIDE/ETC. MATLS TO AVOID: ALCOHOL/WOOD/TURPENTINE, METAL POWDERS/HYDROGEN SULFIDE/ETC. CONT W/STRONG BASES WILL CAUSE VIOLENT SPLATTERING.EFTS OF OVEREXP:INCL BURNING SENSATION, COUGH, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HDCH, NAUS & VOMIT.

==========

Physical/Chemical Properties

==========

HCC: C1

Spec Gravity: APPROXIMATELY 1

Solubility in Water: SOLUBLE

Appearance and Odor: TRANSPARENT WITH AN ACRID ODOR.

==========

Reactivity Data

==========

Stability Indicator: YES

Stability Condition To Avoid: ELEVATED TEMPERATURES MAY CAUSE CONTAINERS TO BURST AND LIBERATE TOXIC NOX.

Materials To Avoid: CONC HNO3 IS A POWERFUL OXIDIZING AGENT. IT REACTS

EXPLO W/COMBUST ORG/READILY OXIDIZABLE MATLS SUCH AS; (SUPP DATA)
Hazardous Decomposition Products: WILL RELEASE TOXIC NITROGEN OXIDE FUMES AND VAPORS.
Hazardous Polymerization Indicator: NO
Conditions To Avoid Polymerization: NOT RELEVANT
==========
Toxicological Information
==========
==========
Ecological Information
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==========
MSDS Transport Information
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==========
Regulatory Information
==========
==========
Other Information
==========
==========
Transportation Information
==========
Responsible Party Cage: 07977
Trans ID NO: 25204
Product ID: NITRIC ACID BLANK, PLBLK-HN03
MSDS Prepared Date: 03/04/1988
Review Date: 01/17/1992
Article W/O MSDS: N
Multiple KIT Number: 0
Unit Of Issue: NK
Container QTY: NK
==========
Detail DOT Information
==========
DOT PSN Code: KFD
DOT Proper Shipping Name: NITRIC ACID
DOT PSN Modifier: OTHER THAN RED FUMING, WITH NOT MORE THAN 70 PERCENT NITRIC ACID
Hazard Class: 8
UN ID Num: UN2031
DOT Packaging Group: II
Label: CORROSIVE
Special Provision: B2,B47,B53,T9,T27
Non Bulk Pack: 158
Bulk Pack: 242
Max Qty Pass: FORBIDDEN
Max Qty Cargo: 30 L
Vessel Stow Req: D
Water/Ship/Other Req: 44,66,89,90,110,111
==========
Detail IMO Information
==========
IMO PSN Code: KPF
IMO Proper Shipping Name: NITRIC ACID
IMO PSN Modifier: ,OTHER THAN RED FUMING,ALL CONCENTRATIONS
IMDG Page Number: 8195
UN Number: 2031
UN Hazard Class: 8
IMO Packaging Group: I/II
Subsidiary Risk Label: -

EMS Number: 8-03
MED First Aid Guide NUM: 610
==========
Detail IATA Information
==========
IATA PSN Code: RWI
IATA UN ID Num: 2031
IATA Proper Shipping Name: NITRIC ACID
IATA PSN Modifier: ,OTHER THAN RED FUMING, WITH 20% OR LESS NITRIC ACID
IATA UN Class: 8
IATA Label: CORROSIVE
UN Packing Group: II
Packing Note Passenger: 807
Max Quant Pass: 1L
Max Quant Cargo: 30L
Packaging Note Cargo: 813
==========
Detail AFI Information
==========
AFI PSN Code: RWI
AFI Symbols: T
AFI Proper Shipping Name: NITRIC ACID
AFI PSN Modifier: ,OTHER THAN RED FUMING, WITH LESS THAN 20% NITRIC ACID
AFI Hazard Class: 8
AFI UN ID NUM: UN2031
AFI Packing Group: II
AFI Label: CORROSIVE
Back Pack Reference: A12.11
==========
HAZCOM Label
==========
Product ID: NITRIC ACID BLANK, PLBLK-HN03
Cage: 07977
Company Name: SPEX CERTIPREP INC
Street: 203 NORCROSS AVE
City: METUCHEN NJ
Zipcode: 08840 US
Health Emergency Phone: 201-549-7144
Date Of Label Review: 10/18/1991
Label Date: 10/18/1991
Chronic Hazard IND: N
Eye Protection IND: YES
Skin Protection IND: YES
Signal Word: DANGER
Respiratory Protection IND: YES
Health Hazard: Moderate
Contact Hazard: Severe
Fire Hazard: None
Reactivity Hazard: None
Hazard And Precautions: ACUTE: CORROSIVE & FATAL IF TOO MUCH IS INHALED/ABSORBED THRU SKIN. CAUSES SEVERE EYE BURNS WHICH MAY RESULT IN PERMANENT DMG & VISUAL IMPAIRMENT. CAUSES SKIN BURNS, DEEP ULCERS & YELLOW/YELLOWISH BRO WN STAINS ON SKIN. SWALLOWING LIQ WILL CAUSE IMMEDIATE PAIN & BURNS OF MOUTH, ESOPHAGUS & GI TRACT. INHAL MAY BE FATAL CAUSING SPASM, INFLAM & EDEMA OF LARYNX & BRONCHI, CHEM PNEUMONIA & PULM EDEMA. A VOID INHAL, INGEST & EYE/SKIN CONTACT. CHRONIC EFTS: VAPOR & MIST MAY ERODE EXPOSED TEETH WITH PROLONGED EXPOSURE.

==========

Disclaimer (provided with this information by the compiling agencies):
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ISOBUTYLENE

AIRGAS INC -- ISOBUTYLENE-C4H8
==========
MSDS Safety Information
==========
FSC: 6665
NIIN: 01-214-8247
MSDS Date: 01/16/1998
MSDS Num: CLCRL
Product ID: ISOBUTYLENE-C4H8
MFN: 01
Responsible Party
Cage: UO451
Name: AIRGAS INC
Address: 259 RADNOR-CHESTER RD SUITE 100
City: RADNOR PA 19087-5240
Info Phone Number: 1-610-687-5253
Emergency Phone Number: (800)424-9300
Resp. Party Other MSDS No.: DOCUMENT NUMBER: 1031
Chemtrec IND/Phone: (800)424-9300
Published: Y
==========
Preparer Co. when other than Responsible Party Co.
==========
Cage: 0KBF5
Name: CHEMICAL SAFETY ASSOCIATES INC
Address: 9163 CHESAPEAKE DR
City: SAN DIEGO CA 92123-1002
==========
Contractor Summary
==========
Cage: UO451
Name: AIRGAS INC
Address: 259 RADNOR-CHESTER RD SUITE 100
City: RADNOR PA 19087-5240
Phone: 1-610-687-5253
Cage: 7Z016
Name: KAMPI COMPONENTS CO., INC.
Address: 210 RT 13
Box: 721
City: BRISTOL PA 19007-3517
Phone: 215-736-2000
Contract Number: SP0440-00-M-JA63
==========
Item Description Information
==========
Item Manager: S9G
Item Name: CALIBRATION GAS CYL
Specification Number: NONE
Type/Grade/Class: NONE
Unit of Issue: EA
UI Container Qty: 1
Type of Container: CYLINDER
==========
Ingredients
==========
Cas: 115-11-7
RTECS #: UD0890000
Name: ISOBUTYLENE
> Wt: 90.

Name: MAXIMUM IMPURITIES
< Wt: 1.
==========
Health Hazards Data
==========
Route Of Entry Inds - Inhalation: YES
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: ACUTE: THE MOST SIGNIFICANT HAZARD IS OXYGEN-DEFICIENT ATOMSPHERES. AT HIGH CONCENTRATIONS UNCONSCIOUSNESS OR DEATH MAY OCCUR. CONTACT WITH LIQUIDFIED GAS OR RAPIDLY EXPANDING GASES MAY CAUSE FROSTBIT E. ISOBUTYLENE ALSO HAS SOME DEGREE OF ANESTHETIC ACTION AND CAN BE MILDLY IRRITATING TO THE MUCOUS MEMBRANES. CHRONIC: NO KNOWN ADVERSE HEALTH EFFECTS ASSOCIATED WITH CHRONIC EXPOSURE TO ISOBUTYLENE. TARGET ORGANS: RESPIRATORY SYSTEM.
Explanation Of Carcinogenicity: ISOBUTYLENE IS NOT FOUND ON THE FOLLOWING LISTS: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA, AND THEREFORE IS NEITHER CONSIDERED TO BE NOR SUSPECTED TO BE A CANCER-CAUSING AGENT BY THESE AGENCIES.
Signs And Symptions Of Overexposure: INHALATION: SYMPTOMS OF OXYGEN DEFICIENCY INCLUDE RESPIRATORY DIFFICULTY, HEADACHES, RINGING IN EARS, DIZZINESS, DROWSINESS, UNCONSCIOUSNESS, NAUSEA, VOMITING, AND DEPRESSION OF ALL THE SENSES. UNDER SOME CIRCUSTANCES OF OVEREXPOSURE, DEATH MAY OCCUR.
First Aid: RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO ISOBUTYLENE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. AT A MINIMUM, SELF-CONTAINED BREATHING APPARATUS AND FIRE-RETARDANT PERSONAL PROTECTIVE EQUIPMENT SHOULD BE WORN. FIRE PROTECTION MUST BE PROVIDED DURING RESCUE SITUATIONS. REMOVE VICTIMS(S) TO FRESH AIR. TRAINED PERSONNEL SHOULD ADMINISTER OXYGEN AND/OR CARDIO-PULMONARY RESUS CITATION, IF NECESSARY. IN CASE OF FROSTBITE, PLACE FROSTBITEN PART IN WARM WATER. (CONTD. SEE OTHER INFORMATION)
==========
Handling and Disposal
==========
Spill Release Procedures: UNCONTROLLED RELEASES SHOULD BE COVERED BY TRAINED PERSONNEL USING PRE-PLANNED PROCEDURES. PROPER PROTECTIVE EQUIPMENT SHOULD BE USED. ADEQUATE FIRE PROTECTION MUST BE PROVIDED. MINIMUM PERSONAL PROTE CTIVE EQUIPMENT SHOULD BE LEVEL B: FIRE RETARDANT PROTECTIVE CLOTHING, GLOVES RESISTANT TO TEARS AND SELF CONTAINED BREATHING APPARATUS. USE NON-SPARKING TOOLS AND (CONTD. SEE "WASTE DISPOSAL))
Waste Disposal Methods: WASTE DISPOSAL MUST BE IN ACCORDANCE WITH APPROPRIATE FEDERAL, STATE, AND LOCAL REGULTIONS. RETURN CYLINDERS WITH ANY RESIDUAL PRODUCT TO AIRGAS INC. DO NOT DISPOSE OF LOCALLY. (CONTD. FROM "SPILL REL EASE") EQUIPMENT. IF NOT ABLE TO STOP RELEASE, ALLOW GAS TO RELEASE IN PLACE OR REMOVE TO A SAFE ARE A AND ALLOW GAS TO RELEASE.
Handling And Storage Precautions: STORE IN COOL(,< 125F), DRY, WELL-VENTILATED AREA AWAY FROM SOURCES OF HEAT, IGNITION, DIRECT SUNLIGHT. COMPRESSED GASES PRESENT SAFETY HAZARD. STORE AWAY FROM OXIDIZERS, OXIGEN, CHLORINE, FLUORINE, H EAVILY TRAFFICKED AREAS, EMERGENCY EXITS. POST "NO SMOKING OR NO OPEN FLAMES " SIGNS.
Other Precautions: ELECTRICAL EQUIPMENT SHOULD BE NON-SPARKING. MOVE CYLINDERS WITH HAND TRUCK. DO NOT DRAG, ROLL, DROP, STRIKE EACH OTHER. SECURE FIRMLY. DO NOT HEAT CYLINDER OR USE OILS OR GREASE ON GAS-HANDLING FITTI NGS OR EQUIPMENT. USE DESIGNATED CGA FITTINGS. DO NOT USE ADAPTERS. USE CHECK VALVE OR TRAP IN DISCH ARGE LINE.
==========
Fire and Explosion Hazard Information
==========
Flash Point Method: CC
Flash Point: <-10.C, 14.F

Autoignition Temp: =465.C, 869.F
Lower Limits: 1.8
Upper Limits: 9.6
Extinguishing Media: EXTINGUISH ISOBUTYLENE FIRES BY SHUTTING OFF THE SOURCE OF THE GAS. USE WATER SPRAY OR A FOAM AGENT TO COOL FIRE-EXPOSED CONTAINERS, STRUCTURES AND EQUIPMENT.
Fire Fighting Procedures: STRUCTURAL FIREFIGHTERS MUST WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE EQUIPMENT. THE BEST FIRE-FIGHTING TECHNIQUE MAY BE SIMPLY TO LET THE BURNING GAS ESCAPE FROM THE PRESSURIZED CY LINDER, TANK CAR, OR PIPELINE. STOP THE LEAK BEFORE EXTINGUISHING FIRE. LEAKING GAS COULD EXPLOSIVELY RE-IGNITE.
Unusual Fire/Explosion Hazard: WHEN INVOLVED IN A FIRE, THIS MATERIAL MAY IGNITE AND PRODUCE TOXIC GASES, INCLUDING CARBON MONOXIDE AND CARBON DIOXIDE.
==========
Control Measures
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Respiratory Protection: MAINTAIN OXYGEN LEVELS ABOVE 19.5% IN THE WORKPLACE. USE SUPPLIED AIR RESPIRATORY PROTECTION IF OXYGEN LEVELS ARE BELOW 19.5% OR DURING EMERGENCY RESPONSE TO A RELEASE OF ISOUTYLENE. IF RESPIRATORY PR OTECTION IS REQUIRED, FOLLOW THE REQUIREMENTS OF THE FEDERAL OSHA RESPIRATORY STANDARD (29 CFR 1910.134) OR EQUIVALENT STATE STANDARDS.
Ventilation: USE ADEQUATE VENTILATION. LOCAL EXHAUST VENTILATION IS PERFERRED, BECAUSE IT PREVENTS ISOBUTYLENE DISPERSION INTO THE WORKPLACE BY EMLIMINATING IT AT THE SOURCE
Protective Gloves: RESISTANT TO TEARS. USE LOW-TEMPERATURE PROTECTIVE GLOVED (E.G., KEVLAR)
Eye Protection: SPLASH GOGGLES OR SAFETY GLASSES.
Other Protective Equipment: USE BODY PROTECTION . TRANSFER OF LARGE QUANTITIES UNDER PRESSURE MAY REQUIRE PROTECTIVE EQUIPMET TO PROTECT FROM SPLASHES OF LIQUIDFIED PRODUCT AS WELL AS FIRE RETARANAT ITEMS.
Work Hygienic Practices: AS WITH ALL CHEMICALS, AVOID GETTING ISOBUTYLENE IN YOU. DO NOT EAT OR DIRNK WHILE HANDLING CHEMICALS. BEWARE OF ANY SIGNS OF DIZZINESS OR FATIGUE; EXPOSURES TO FATAL CONCENTRATIONS OF ISOBUTYLENE COULD
Supplemental Safety and Health: (CONTD. FROM FIRST AID) DO NOT USE HOT WATER. IF WARM WATER NOT AVAILABLE, OR IMPRACTICAL TO USE, WRAP AFFECTED PARTS GENTLY IN BLANKETS. (SEE OTHER INFORMATION)
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Physical/Chemical Properties
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HCC: G2
Boiling Point: =-6.9C, 19.6F
Melt/Freeze Pt: =-140.C, -220.F
Vapor Pres: 39 PSIA
Vapor Density: 0.15LB/FT3
Spec Gravity: 1.997
PH: NA
Solubility in Water: INSOLUBLE
Appearance and Odor: COLORLESS LIQUID/ GAS WITH THE UNPLEASANT ODOR OF BURNING COAL.
==========
Reactivity Data
==========
Stability Indicator: YES
Stability Condition To Avoid: CONTACT WITH INCOMPATIBLE MATERIALS AND EXPOSURE TO HEAT, SPARKS, AND ORTHER SOURCES OF IGNITION. CYLINDERS EXPOSED TO HIGH TEMPERATURES OR DIRECT FLAME CAN RUPTURE OR BURST.
Materials To Avoid: STRONG OXIDIZERS (E.G., CHLORINE, BROMINE PENTAFLUORIDE, OXYGEN, OXYGEN DIFLUORIDE, AND NITROGEN TRIFLUORIDE).
Hazardous Decomposition Products: WHEN IGNITED IN THE PRESENCE OF OXYGEN, THIS GAS WILL BURN TO PRODUCE CARBON MONOXIDE AND CARBON DIOXIDE.
Hazardous Polymerization Indicator: NO

Conditions To Avoid Polymerization: WILL NOT OCCUR.

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Toxicological Information

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Toxicological Information: LC50 (RAT, INHALATION): 620 G/M3/ 4 HOURS; LC50 (MOUSE, INHALATION): 415 G/M3/ 2 HOUR. ISOBUTYLENE IS NOT FOUND ON FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA, AND THEREFORE IS NEITHER CONSIDERED TO BE N OR SUSPECTED TO BE A CANCER-CAUSING AGENT BY THESE AGENCIES. PRODUCT MAY BE MILDLY IRRITATING TO THE MUCOUS MEMBRANES. IN ADDITION, CONTACT WITH RAPIDLY EXPANDING GASES CAN CAUSE FROSTBITE TO EXPOSED TISSUE. ISOBUTYLENE IS NOT KNOWN TO CAUSE SENSITIZATION IN HUMANS. NO MUTAGENIC EFFECTS, NO EMBRYOTOXIC EFFECTS, NO TERATOGENIC EFFECTS, NO REPRODUCTIVE TOXICITY EFFECTS HAVE BEEN DESCRIBED FOR BUTYLE NE.

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Ecological Information

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Ecological: ENVIRONMENTAL STABILITY: THIS GAS WILL BE DISSIPATED RAPIDLY IN WELL-VENTILATED AREAS. EFFECTS OF MATERIAL ON PLANTS OR ANIMALS: ANY ADVERSE EFFECT ON ANIMALS WOULD BE RELATED TO OXYGEN-DEFICIENT ENVI RONMENTS. NO ADVERSE EFFECT IS ANTICIPATED TO OCCUR TO PLANT LIFE, EXCEPT FOR FROST PRODUCED IN THE PRESENCE OF RAPIDLY EXPANDING GASES. EFFECT OF CHEMICAL ON AQUATIC LIFE: NO EVIDENCE IS CURRENTLY AV AILABLE ON THE EFFECTS OF ISOBUTYLENE ON AQUATIC LIFE.

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MSDS Transport Information

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Transport Information: THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION. PROPER SHIPPING NAME: ISOBUTYLENE; CLASS: 2.1 (FLAMMABLE GAS); UN 1055; PKG: N/A; DOT LABELS REQUIRED: FLAMMABLE GAS; NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115. ALTERNATE DESCRIPTION: PSN: PETROLEUM GASES, LIQUIDFIED; CLASS: 2.1 (FLAMMABLE GAS); UN 1075; PKG N/A; DOT LABEL REQUIRE D: FLAMMABLE GAS; NORTH AMERICAN EMERGENCY GUIDEBOOK NUMBER: 115; MARINE POLLUTANT: ISOBUTYLENE IS NOT CLASSIFIED BY THE DOT AS A MARINE POLLUTANT (AS DEFINED BY 49 CFR 172.101, APPENDIX B). CANADA: SAME AS ABOVE.

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Regulatory Information

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Sara Title III Information: ISOBUTYLENE IS NOT SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 302, 304, AND 313 OF TITLE I I I OF THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT. U.S. SARA THRESHOLD PLANNING QUANTITY: N/A. U. S. CERCLA REPORTABLE QUANTITY (RQ): NOT APPLICIABLE.ING RE

Federal Regulatory Information: ISOBUTYLENE IS LISTED ON THE U.S. TSCA INVENTORY. ISOBUTYLENE IS SUBJECT TO REPORTING REQUIREMENTS OF SECTION 112(R) OF THE CLEAN AIR ACT. THRESHOLD QUANTITY FOR THIS GAS IS 10,000 LB. DEPENDING ON SP ECIFIC OPERATIONS INVOLVING USE OF ISOBUTYLENE, REGULATIONS OF THE PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS MAY BE APPLICABLE (29 CFR 1910.119) UNDER THIS REGULATION ISOBUTYLENE IS NOT LISTED IN APPENDIX A; HOWEVER, ANY PROCESS THAT INVOLVES A FLAMMABLE GAS ON-SITE, IN ONE LOCATION, I N QUANTITIES OF 10,000 LB (4,553 KG) OR GREATER IS COVERED UNDER THIS REGULATION UNLESS IT IS USED AS A FUEL.

State Regulatory Information: CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): ISOBUTYLENE IS NOT ON THE CALIFORNIA PROPOSITION 65 LISTS. PRODUCT COVERED UNDER FOLLOWING STATE REGULATIONS: AK: DESIGNATED TOXIC AND HAZARDOUS SUBSTANCES. CA: PERMISSIBLE EXPOSURE LIMITS FOR CHEMICAL CONTAMINANTS; FL:SUBSTANCE LIST; MA: SUBSTANCE LIAT; MN:LIST OF HAZARDOUS SUBSTANCES; NJ: RIGHT TO KNOW HAZARDOUS SUBSTANCE LIST; PA: HAZARDOUS SUBSTANCE LIST; RI: HAZARDOUS SUBSTANCE LIST; TX: HAZARDOUS SUBSTANCE LIST: WV: HAZARDOUS SUBSTANCE LIST; WI: TOXIC AND HAZARDOUS SUBSTANCES.

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Other Information
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Other Information: (CONTD. FROM FIRST AID) DO NOT USE HOT WATER. IF WARM WATER NOT AVAILABLE, WRAP AFFECTED PARTS IN BLANKETS. ALTERNATIVELY, IF FINGERS OR HANDS ARE FORTBITTEN, PLACE IN ARMPIT. HAVE VICTIM GENTLY EXERC ISE AFFECTED PARTS WHILE BEING WARMED. SEEK MEDICAL ATTENTION. TAKE COPY OF LABEL AND MSDS TO PHYSICIAN WITH VICTIM. NFPA RATING: HEALTH: 1; FLAMMIBILITY: 4; REACTIVITY: 0. RATINGS: HEALTH: 1; FLAMMABILITY: 4; REACTIVITY: 0; PROTECTIVE EQUIPMENT: B. CANADIAN W SYMBOLS: CLASS A: COMPRESSED GAS; CLASS B1: FLAMMABLE GAS.
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Transportation Information
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Responsible Party Cage: UO451
Trans ID NO: 156921
Product ID: ISOBUTYLENE-C4H8
MSDS Prepared Date: 01/16/1998
Review Date: 05/14/2001
MFN: 1
Multiple KIT Number: 0
Unit Of Issue: EA
Container QTY: 1
Type Of Container: CYLINDER
Additional Data: TRANSPORTATION DATA PER MANUFACTURER'S MSDS.
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Detail DOT Information
==========
DOT PSN Code: HTR
DOT Proper Shipping Name: ISOBUTYLENE
DOT PSN Modifier: SEE ALSO PETROLEUM GASES, LIQUEFIED
Hazard Class: 2.1
UN ID Num: UN1055
Label: FLAMMABLE GAS
Special Provision: 19
Packaging Exception: 306
Non Bulk Pack: 304
Bulk Pack: 314,315
Max Qty Pass: FORBIDDEN
Max Qty Cargo: 150 KG
Vessel Stow Req: E
Water/Ship/Other Req: 40
==========
Detail IMO Information
==========
IMO PSN Code: IRQ
IMO Proper Shipping Name: ISOBUTYLENE
IMDG Page Number: 2147
UN Number: 1055
UN Hazard Class: 2(2.1)
IMO Packaging Group: -
Subsidiary Risk Label: -
EMS Number: 2-07
MED First Aid Guide NUM: 310
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Detail IATA Information
==========
IATA PSN Code: OHI
IATA UN ID Num: 1055
IATA Proper Shipping Name: ISOBUTYLENE
IATA UN Class: 2.1
IATA Label: FLAMMABLE GAS

Packing Note Passenger: FORB
Max Quant Pass: FORB
Max Quant Cargo: 150KG
Packaging Note Cargo: 200
Exceptions: A1
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Detail AFI Information
==========
AFI PSN Code: OHI
AFI Proper Shipping Name: ISOBUTYLENE
AFI Hazard Class: 2.1
AFI UN ID NUM: UN1055
Special Provisions: P4
Back Pack Reference: A6.3, A6.5
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HAZCOM Label
==========
Product ID: ISOBUTYLENE-C4H8
Cage: UO451
Assigned IND: Y
Company Name: AIRGAS INC
Street: 259 RADNOR-CHESTER RD SUITE 100
City: RADNOR PA
Zipcode: 19087-5240
Health Emergency Phone: (800)424-9300
Label Required IND: Y
Date Of Label Review: 05/14/2001
Status Code: A
Label Date: 05/14/2001
Origination Code: F
Eye Protection IND: YES
Skin Protection IND: YES
Signal Word: DANGER
Respiratory Protection IND: YES
Health Hazard: Moderate
Contact Hazard: Moderate
Fire Hazard: Severe
Reactivity Hazard: None
Hazard And Precautions: FLAMMABLE LIQUID AND GAS UNDER PRESSURE. CAN FORM EXPLOSIVE MIXTURES WITH AIR. MAY CAUSE FROSTBITE. KEEP AWAY FROM HEAT (< 125F), FLAMES, AND SPARKS. STORE AND USE WITH ADEQUATE VENTILATION. MOST SIGN IFICANT HAZARD IS OXYGEN-DEFICIENT ATOMSPHERES.
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Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever expressly or implied warrants, states, or intends said information to have any application, use or viability by or to any person or persons outside the Department of Defense nor any person or persons contracting with any instrumentality of the United States of America and disclaims all liability for such use. Any person utilizing this instruction who is not a military or civilian employee of the United States of America should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation regardless of similarity to a corresponding Department of Defense or other government situation.

HCL/
MURIATIC ACID

OLIN CORPORATION -- HCL (MURIATIC ACID), CPE298002

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MSDS Safety Information

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FSC: 6810
NIIN: 00-045-8918
MSDS Date: 03/28/1997
MSDS Num: CHVMT
Product ID: HCL (MURIATIC ACID), CPE298002
MFN: 02
Responsible Party
Cage: 99530
Name: OLIN CORPORATION
Address: 501 MERRITT 7
Box: 4500
City: NORWALK CT 06856-4500
Info Phone Number: 203-356-3449
Emergency Phone Number: 800-OLIN-911(1-800-654-6911)
Published: Y

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Contractor Summary

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Cage: 99530
Name: OLIN CORPORATION
Address: 501 MERRITT 7
Box: 4500
City: NORWALK CT 06856-4500
Phone: 203-750-3000/800-511-MSDS

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Item Description Information

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Ingredients

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Cas: 7647-01-0
RTECS #: MW4025000
Name: HYDROCHLORIC ACID (SARA 302/313) (CERCLA)
% Wt: 8-38
OSHA PEL: C 5 PPM
ACGIH TLV: C 5 PPM
EPA Rpt Qty: 5000 LBS
DOT Rpt Qty: 5000 LBS

Cas: 7732-18-5
Name: WATER
% Wt: 62-93
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Name: SUP DAT: OCCUR TO ENTIRE GI TRACT, INCL STOM & INTESTINES, CHARACTERIZED BY NAUS, VOMIT, DIARR, ABDOM PAIN,

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Name: ING 3: BLEEDING, &/TISS ULCERATION. INGEST CAUSES SEVERE DAMAGE TO GI TRACT W/POTENTIAL TO CAUSE PERFORATION.

Name: ING 4: CHRONIC: INHAL: RPTD/PRLNG EXPOS TO CONCS >ACCEPTED OCCUP LIMS MAY CAUSE DENTAL DISCOLORATION & EROSION

Name: ING 5: OF TEETH. SKIN: RPTD CONT W/MIST HAS BEEN REPORTED TO CAUSE CONT DERM (SKIN RASH). PRLNG/RPT EXPOS W/LIQ

Name: ING 6: MAY CAUSE PERM DMG. INGEST: INGEST OF SIGNIFICANT AMTS IS UNLIKELY BECAUSE OF ITS ACUTE CORR ACTION.

Name: FIRST AID PROC: INHAL: IF PERS EXPERIENCES NAUS, HDCH/DIZZ, PERS SHOULD STOP WORK IMMED & MOVE TO FRESH AIR

Name: ING 8: UNTIL THESE SYMPS DISAPPEAR. IF BRTHG IS DFCLT, ADMIN OXYGEN, KEEP PERS WARM & AT REST. CALL MD. IN THE

Name: ING 9: EVENT THAT INDIVIDUAL INHALES ENOUGH VAP TO LOSE CONSCIOUSNESS, PERS SHOULD BE MOVED TO FRESH AIR AT ONCE

Name: ING 10: & MD SHOULD BE CALLED IMMED. IF BRTHG HAS STOPPED, ARTF RESP SHOULD BE GIVEN IMMED. IN ALL CASES, ENSURE

Name: ING 11: ADEQUATE VENTILATION AND PROVIDE RESPIRATORY PROTECTION BEFORE THE PERSON RETURNS TO WORK.

Name: SPILL PROC: REQS. HAZ CONCS IN AIR MAY BE FOUND IN LOC SPILL AREA & IMMED DOWNWIND. AIR RELEASE. VAPS MAY BE

Name: ING 13: SUPPRESSED BY USE OF WATER FOG/VAP SUPPRESSANT FOAM. DIKE & CONTAIN ALL RUN-OFF WATER FOR TREATMENT AS

Name: ING 14: HAZ WASTE. WATER RELEASE: THIS MATL IS HVR/AIR & SOL IN WATER. CONTAIN CONTAM WATER BY BLDG A DIKE OF

Name: ING 15: COMPATIBLE ABSORBS. VACUUM/PUMP MATL TO NEUT CONTR & TREAT. LAND SPILL: COMPATIBLE ABSORBS: SAND, CLAY

Name: ING 16: SOIL & COMMERCIAL ABSORBS. SPILL RESIDUERS: DISP OF PER GUIDELINES UNDER WASTE DISP. THIS MATL MAY BE

Name: ING 17: NEUT FOR DISP; YOU ARE REQUESTED TO CONT OCEAN AT 800-OLIN-911 BEFORE BEGINNNING ANY SUCH OPERATION.
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Health Hazards Data
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LD50 LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry Inds - Inhalation: YES
Skin: YES
Ingestion: YES
Carcinogenicity Inds - NTP: NO
IARC: NO
OSHA: NO
Effects of Exposure: ACUTE: INHAL: MIST/VAP/HYDROGEN CHLORINE GAS MAY CAUSE IRRIT OF MUC MEMB & RESP TRACT W/SYMPS OF BURNING, CHOKING * COUGHING. AT EXPOS CONCS >TLV, DMG MAY OCCUR TO MUC MEMB (ULCERATIONS OF NOSE & THRO AT) & RESP TRACT. AT THESE HIGH CONCS, SEV BRTHG DFCLTYS MAY OCCUR WHICH MAY BE DELAYED IN ONSET & MAY (EFTS OF OVEREXP)
Explanation Of Carcinogenicity: NOT RELEVANT.
Signs And Symptions Of Overexposure: HLTH HAZ: BE DUE TO PULM EDEMA (FLUID IN LUNG) /LARYNGEAL EDEMA/SPASM. SKIN: HYDROFLUORIC ACID MIST MAY RAPIDLY CAUSE SKIN INFLAMM & BURNS. DIRECT CONT OF LIQ WILL BE CORR TO SKIN & CAN CAUSE SEV IRRI T &/BURNS CHARACTERIZED BY REDNESS, SWELL & SCAB FORM. POTENTIAL FOR SCARRING & ULCERATION OF CONTACTED TISS (SUP DAT)
Medical Cond Aggravated By Exposure: RESPIRATORY AND CARDIOVASCULAR DISEASE.
First Aid: EYES: IMMED FLUSH W/LGE AMTS OF WATER FOR AT LEAST 15 MIN, OCCAS LIFTING UPPER & LOWER EYELIDS. CALL MD AT ONCE. SKIN: IMMED FLUSH W/WATER FOR AT LEAST 15 MIN. CALL MD. IF CLTHG COMES IN CONT W/PROD, IT SHOULD BE REMOVED IMMED & LAUNDERED BEFORE REUSE. INGEST: IMMED DRINK LGE QTYS OF

WATER. DO NOT INDUCE VOMIT. CALL MD AT ONCE. DO NOT GIVE ANYTHING BY MOUTH IF PERS IS UNCON/HAVING CONVLS.

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Handling and Disposal

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Spill Release Procedures: FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC AT 800-424-9300. REPORTABLE QUANTITY: THIS PROD IS SUBJECT TO REPORTABLE QTY W/RESPECT TO HYDROFLUORIC ACID. RQ'S ARE SUBJECT TO CHANGE & REFERENCE SHOU LD BE MADE TO 40 CFR 302.4 FOR CURRENT

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Methods: CARE MUST BE TAKEN TO PVNT ENVIRON CONTAM FROM USE OF MATL. THE USER HAS THE RESPONSIBILITY TO DISP OF UNUSED MATL, RESIDUES & CONTRS IN COMPLIANCE W/ALL RELEVANT LOC, STATE & FED LAWS & REGS REGARDIN G TREATMENT, STOR & DISP FOR HAZ & NON HAZ WASTES

Handling And Storage Precautions: DO NOT TAKE INTERNALLY. AVOID CONT W/SKIN, EYES & CLTHG. AVOID BRTHG MIST/VAP. STORE IN COOL, CLEAN, WELL-VENTED AREA. DO NOT STORE >100F (>38C).

Other Precautions: DO NOT EXPOSE TO DIRECT LIGHT. SHELF LIFE LIMITATIONS: 1 YEAR. GLASS/POLYETHYLENE CONTRS REC. WHEN SHIPPED W/OXIDIZERS, MUST BE SEPARATED BY 18 INCHES, W/WOOD PALLETS & ABSORB MATL IN BETWEEN.

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Fire and Explosion Hazard Information

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Extinguishing Media: ON SMALL FIRES, USE DRY CHEMICAL OR CARBON DIOXIDE. ON LARGE FIRE, USE WATER.

Fire Fighting Procedures: WEAR NIOSH APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N). USE WATER TO COOL CONTAINERS EXPOSED TO FIRE.

Unusual Fire/Explosion Hazard: NOT COMBUSTIBLE BUT CONTACT WITH COMMON METALS PRODUCES FLAMMABLE HYDROGEN GAS. MAY ALSO RELEASE CHLORINE GAS BY REACTION WITH OXIDIZING AGENTS.

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Control Measures

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Respiratory Protection: NONE SPECIFIED BY MANUFACTURER.ALLY REQUIRED. IF VAPORS, MISTS, OR AEROSOLS ARE GENERATED, WEAR A NIOSH APPROVED FULL FACEPIECE, EQUIPPED WITH CHEMICAL CARTRIDGES APPROVED FOR HYDROGEN CHLORIDE.

Ventilation: N/R EXHST VENT IS REC IF VAPS, MIST/AEROSOLS ARE GENERATED.OTHERWISE, USE GOOD GENERAL ROOM VENTILATION.

Protective Gloves: NEOPRENE GLOVES.

Eye Protection: ANSI APRV CHEM SFTY GOGGS&FFACE SHLD(FPN

Other Protective Equipment: ANSI APPRVD EMER EYEWASH & DELUGE SHOWER (FP N). BOOTS, APRON.FULL IMPERMEABLE SUIT REC IF EXPOS TO LGE PORTION OF BODY.

Work Hygienic Practices: UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER.

Supplemental Safety and Health: MATLS TO AVOID: METALLIC OXIDES, MAGNESIUM, OLEUM, PERCHLORIC ACID, ZINC. EFTS OF OVEREXP: ALSO EXISTS. EYE: EXPOS TO MIST MAY RSLT IN IRRIT &/SEV BURNS W/PERM DMG & POSS LOSS OF SIGHT. DIRECT CONT W/ LIQ WILL BE CORR TO EYE W/RSLTG SEV BURNS, POTENTIAL VISUAL IMPAIRMENT/LOSS OF SIGHT. INGEST: IRRIT &/BURNS CAN

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Physical/Chemical Properties

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B.P. Text: >212F,100C

M.P/F.P Text: -101F,-74C

Vapor Pres: <210 @ 20C

Vapor Density: 1.3

Spec Gravity: 1.035-1.188

PH: <1

Evaporation Rate & Reference: APPROX 1 (WATER=1)

Solubility in Water: COMPLETE

Appearance and Odor: CLEAR, COLORLESS LIQUID; PUNGENT, SUFFOCATING ODOR

Percent Volatiles by Volume: 100

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Reactivity Data
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Stability Indicator: YES
Stability Condition To Avoid: HEAT, EXPOSURE TO SUNLIGHT.
Materials To Avoid: ALKALINE MATLS, ALUMINUM, AMINES, CARBONATES, IRON, SULFURIC ACID, HYDROXIDES, LEATHER & OTHER FABRICS, (SUP DAT)
Hazardous Decomposition Products: FLAMM HYDROGEN GAS BY REACTION W/MANY METALS (E.G. ALUMINUM). CHLORINE GAS IS RELEASED BY REACTION W/OXIDIZING AGENTS.
Hazardous Polymerization Indicator: NO
Conditions To Avoid Polymerization: NOT RELEVANT.
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Toxicological Information
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Ecological Information
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MSDS Transport Information
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Regulatory Information
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Other Information
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HAZCOM Label
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Product ID: HCL (MURIATIC ACID), CPE298002
Cage: 99530
Company Name: OLIN CORPORATION
Street: 501 MERRITT 7
PO Box: 4500
City: NORWALK CT
Zipcode: 06856-4500
Health Emergency Phone: 800-OLIN-911; (1-800-654-6911)
Label Required IND: Y
Date Of Label Review: 06/23/1998
Status Code: C
Label Date: 06/23/1998
Origination
Chronic Hazard IND: Y
Eye Protection IND: YES
Skin Protection IND: YES
Signal Word: DANGER
Respiratory Protection IND: YES
Health Hazard: Slight
Contact Hazard: Severe
Fire Hazard: None
Reactivity Hazard: None
Hazard And Precautions: ACUTE: INHAL: MIST/VAP/HCL GAS MAY CAUSE IRRIT OF MUCOUS MEMB & RESP TRACT W/BURN SYMPS, CHOKE & COUGH. AT EXPOS >TLV, MAY DMG MUC MEMB & RESP TRACT. AT HIGH CONC, SEV BRTHG DFCLTYS WHICH MAY BE DELAY ED IN ONSET & BE DUE TO PULM EDEMA, LARYNGEAL EDEMA/SPASM. SKIN: HCL ACID MIST MAY CAUSE INFLAM & BURNS. DIRECT CONT OF LIQ IS CORR CAUSING SEV IRRIT &/BURNS & ULCER OF CONTACTED TISS. EYE: EXPOS TO M IST MAY CAUSE IRRIT &/SEV BURNS W/PERM DMG & POSS SIGHT LOSS. INGEST: IRRIT &/BURNS CAN OCCUR TO GI TRACT. CHRONIC: RPTD/PRLNG EXPOS TO HI CONC MAY CAUSE DENTAL DISCOLOR & EROSION. SKIN: DERM. PERM DM G. INGEST: INLIKELY BECAUSE OR ACUTE CORR ACTION.

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Disclaimer (provided with this information by the compiling agencies): This information is formulated for use by elements of the Department of Defense. The United States of America in no manner whatsoever expressly or implied warrants, states, or intends said information to have any application, use or viability by or to any person or persons outside the Department of Defense nor any person or persons contracting with any instrumentality of the United States of America and disclaims all liability for such use. Any person utilizing this instruction who is not a military or civilian employee of the United States of America should seek competent professional advice to verify and assume responsibility for the suitability of this information to their particular situation regardless of similarity to a corresponding Department of Defense or other government situation.

Appendix B
Standard Operating Procedures

Standard Operating Procedure Contents

Installation of Shallow Monitoring Wells

Groundwater Sampling from Monitoring Wells

Field Measurements of pH, Specific Conductance Turbidity, Dissolved Oxygen, Eh, and Temperature Using the Horiba[R] U-22 with Flow-through Cell

Waste Handling

STANDARD OPERATING PROCEDURE

Installation of Shallow Monitoring Wells

I. Purpose and Scope

The purpose of this guideline is to describe methods for drilling and installation of shallow monitoring wells and piezometers in unconsolidated or poorly consolidated materials using hollow stem augers or mud rotary. Installing monitoring wells in unconsolidated materials using sonic drilling is discussed in SOP *Installation of Monitoring Wells Using Sonic Drilling*. Methods for drilling and installing bedrock monitoring wells and deep, surface-cased wells in unconsolidated materials are presented in SOPs *Installation of Bedrock Monitoring Wells* and *Installation of Surface-Cased Monitoring Wells*, respectively.

II. Equipment and Materials

Drilling

- Drilling rig (hollow stem auger or mud rotary) and associated tools and equipment

Well Riser/Screen

- Polyvinyl chloride (PVC), Schedule 40, minimum 2-inch ID, flush-threaded riser; alternatively, stainless-steel riser
- PVC, Schedule 40, minimum 2-inch ID, flush-threaded, factory slotted screen; alternatively, stainless-steel screen.

Bottom Cap

- PVC, threaded to match the well screen; alternatively, stainless steel
- Centering Guides (if used)

Well Cap

- Above-grade well completion: PVC, threaded or push-on type, vented
- Flush-mount well completion: PVC, locking, leak-proof seal
- Stainless steel to be used as appropriate

Sand

- Clean silica sand, provided in factory-sealed bags, well-rounded, containing no organic material, anhydrite, gypsum, mica, or calcareous material; primary (coarse) filter pack, and secondary (fine) filter pack. Grain size determined based on sediments observed during drilling.

Bentonite

- Pure, additive-free bentonite pellets or chips
- Pure, additive-free powdered bentonite
- Coated bentonite pellets; coating must biodegrade within 7 days
- Cement-Bentonite Grout: proportion of 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 6 pounds of bentonite added per bag of cement to reduce shrinkage

Protective Casing

- Above-grade well completion: 6-inch minimum ID steel pipe with locking cover, diameter at least 2 inches greater than the well casing, painted with epoxy paint for rust protection; heavy duty lock; protective posts if appropriate
- Flush-mount well completion: Morrison 9-inch or 12-inch 519 manhole cover, or equivalent; rubber seal to prevent leakage; locking cover inside of road box

Well Development

- Double surge block with solid bottom, top open, separated by 2 feet of slotted pipe
- Well-development pump, and associated equipment
- Containers (e.g., DOT-approved 55-gallon drums) for water produced from well.

III. Procedures and Guidelines

A. Drilling Method

Typically, continuous-flight hollow-stem augers with a minimum 6-inch inside diameter (ID) will be used to drill shallow monitoring well boreholes. Alternatively, mud rotary may be used. Split-spoon samples will be collected at selected intervals for chemical analysis and/or lithologic classification. Soil sampling procedures are detailed in SOP *Soil Boring Sampling – Split Spoons*.

The use of water to assist in hollow-stem auger drilling for monitoring well installation will be avoided, unless required for such conditions as running sands.

Hollow-stem augers, drilling bits, rods, split-spoon samplers, and other downhole drilling tools will be properly decontaminated prior to the initiation of drilling activities and between each borehole location. Split-spoon samplers and other downhole soil sampling equipment will also be

properly decontaminated before and after each use. SOP *Decontamination of Drill Rigs and Equipment* details proper decontamination procedures.

Drill cuttings and decontamination fluids generated during well drilling activities will be contained according to the procedures detailed in the Field Sampling Plan.

Mud rotary or other rotary drilling may be used instead of hollow-stem augers. The use of added mud should be kept to a minimum.

B. Monitoring Well Installation

Shallow monitoring wells will be constructed inside the hollow-stem augers, once the borehole has been advanced to the desired depth, or in the mudded borehole once the drilling rods have been withdrawn. If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole will be backfilled with bentonite pellets or chips or a bentonite-cement slurry to a depth approximately 1 foot below the intended well depth. Approximately 1 foot of clean sand will be placed on top of the bentonite to return the borehole to the proper depth for well installation.

The appropriate lengths of well screen, nominally 10 feet (with bottom cap), and casing will be joined watertight and lowered inside the augers to the bottom of the borehole. Centering guides, if used, will be placed at the bottom of the screen and above the interval in which the bentonite seal is placed.

Selection of the filter pack and well screen intervals for the shallow monitoring wells shall be made in the field. Based on lithologic samples previously obtained at the site, and comparison with samples to be obtained in the well borings, standard well screen slot of 0.010-inch and silica sand gradations conforming to Morie #2 are anticipated.

A primary sand pack (Morie #2) consisting of clean silica sand will be placed around the well screen. The sand will be placed into the borehole at a uniform rate, in a manner that will allow even placement of the sand pack. The augers will be raised gradually during sand pack installation to avoid caving of the borehole wall; at no time will the augers be raised higher than the top of the sand pack during installation. During placement of the sand, the position of the top of the sand will be continuously sounded. The primary sand pack will be extended from the bottom of the borehole to a minimum height of 2 feet above the top of the well screen. A secondary, finer-grained (e.g., Morie #00), sand pack will be installed for a minimum of 1 foot above the coarse sand pack. Heights of the coarse and fine sand packs and bentonite seal may be modified in the field to account for a shallow water table and a small saturated thickness of the surficial aquifer.

A bentonite pellet seal at least 2 feet thick will be placed above the sand pack. The pellets will be placed into the borehole in a manner that will prevent bridging. The position of the top of the bentonite seal will be verified using a weighted tape measure. If all or a portion of the bentonite seal is above the

water table, clean water will be added to hydrate the bentonite. A hydration period of at least 30 minutes will be required following installation of the bentonite seal.

Above the bentonite seal, an annular seal of cement-bentonite grout will be placed. The cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface through a tremie pipe. The tremie pipe must be plugged at the bottom and have small openings along the sides of the bottom 1-foot length of pipe. This will allow the grout to diffuse laterally into the borehole and not disturb the bentonite pellet seal.

For monitoring wells that will be completed above-grade, a locking steel protective casing set in a concrete pad will be installed. The steel protective casing will extend at least 3 feet into the ground and 2 feet above ground but should not penetrate the bentonite seal. The concrete pad will be square or round, with a minimum radius of approximately 3.5 feet. The concrete will be sloped away from the protective casing.

Guard posts may be installed in high-traffic areas for additional protection. Four steel guard posts will be installed around the protective casing, within the edges of the concrete pad. Guard posts will be concrete-filled, at least 3 inches in diameter, and will extend at least 2 feet into the ground and 3 feet above the ground. The protective casing and guard posts will be painted with an epoxy paint to prevent rust.

For monitoring wells with flush-mount completions, Morrison 9-inch or 12-inch 519 manhole cover or equivalent, with a rubber-sealed cover and drain will be installed. The top of the manhole cover will be positioned approximately 1 inch above grade. A square concrete pad, approximately 2 to 3 feet per side, will be installed as a concrete collar surrounding the road box cover, and will slope uniformly downward to the adjacent grade. The road box and installation thereof will be of sufficient strength to withstand normal vehicular traffic.

Concrete pads installed at all wells will be a minimum of 6 inches below grade. The concrete pad will be 12-inches thick at the center and taper to 6-inch thick at the edge. The surface of the pad should slope away from the protective casing to prevent water from pooling around the casing. Protective casing, guard posts, and flush mounts will be installed into this concrete.

Each well will be properly labeled on the exterior of the locking cap or protective casing with a metal stamp indicating the permanent well number.

C. Well Development

Well development will be accomplished using a combination of surging throughout the well screen and pumping, until the physical and chemical parameters of the discharge water that are measured in the field have stabilized and the turbidity of the discharge water is substantially reduced.

Fine-grained materials in the surficial aquifer at the site may not allow low turbidity results to be achieved.

The surging apparatus will include two surge blocks separated by approximately 2 feet of coarsely slotted pipe. The lower surge block will be solid; the upper surge block will be open and attached to riser pipe leading to the ground surface. Water will be pumped continuously from the surge block screened interval throughout the surging process. The pumping will be accomplished by airlift induction methods or using a centrifugal pump or equivalent.

Well development will begin by surging the well screen, starting at the bottom of the screen and proceeding upwards, throughout the screened zone.

Following surging, the well will be pumped to remove the fine materials that have been drawn into the well. During pumping, measurements of pH, temperature, and specific conductance will be recorded.

Development will continue by alternately surging and pumping until the discharge water is free from sand and silt, the turbidity is substantially reduced, and the pH, temperature, and specific conductance have stabilized at regional background levels, based on historical data. Development will continue for a minimum of 30 minutes.

Well development equipment will be decontaminated prior to initial use and after the development of each well. Decontamination procedures are detailed in SOP *Decontamination of Personnel and Equipment*. Water generated during well development will be contained and managed as detailed in the Investigation Derived Waste Management Plan.

IV. Attachments

Schematic diagram of shallow monitoring well construction

CH2MHILL

PROJECT NUMBER	PIEZOMETER OR WELL NUMBER SHEET 1 OF 1

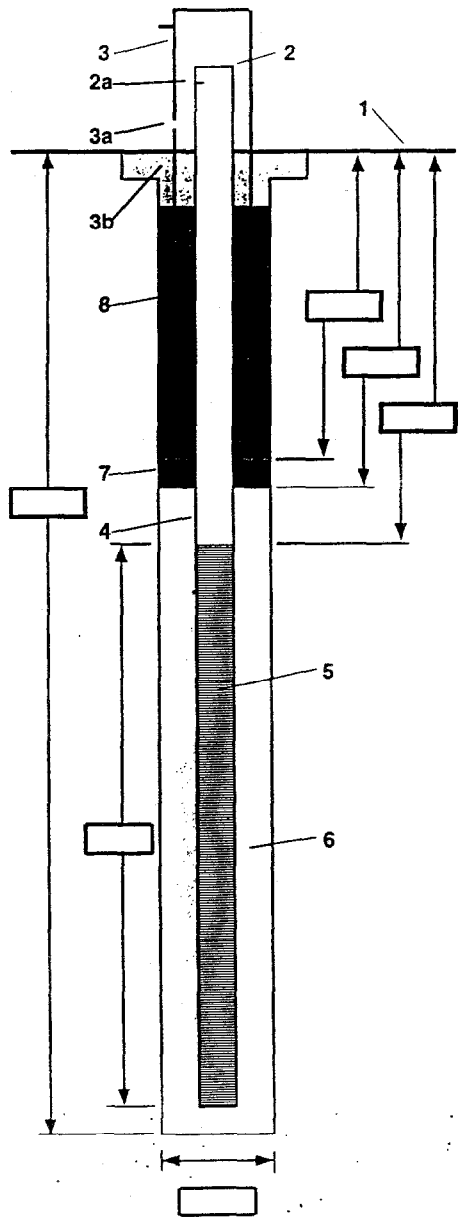
PIEZOMETER OR WELL COMPLETION DIAGRAM

PROJECT : LOCATION :

DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END : LOGGER :



1- *Ground elevation* _____

2- Top of casing elevation _____
a) vent hole? _____

3- Protection cover type _____
a) weep hole? _____
b) concrete pad dimensions _____

4- *Diameter/type of riser* _____
_____

5- Type/slot size of screen _____
_____

6- Type screen filter _____
a) Quantity used _____

7- *Type of seal* _____
a) Quantity used _____

8- Grout
a) Grout mix used _____
b) Method of placement _____
c) Vol. of well casing grout _____

Development method _____

Development time _____

Estimated purge volume _____

Comments _____

STANDARD OPERATING PROCEDURE

Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells. The procedure does not address purging and sampling using "low-flow" techniques (see SOP *Low-Flow Groundwater Sampling from Monitoring Wells).* Operations manuals should be consulted for specific calibration and operating procedures.

II. Equipment and Materials

- Probe box with inlet/outlet ports for purged groundwater and watertight ports for each probe
- pH meter: Orion® Model SA250 or equivalent
- Temperature/conductivity meter: YSI® Model 33 or equivalent
- Dissolved oxygen meter: YSI® Model 57 or equivalent
- In-line disposable 0.45µ filters: QED® FF8100 or equivalent
- Bailer, teflon or stainless steel
- Peristaltic pump, bladder pump, or submersible sampling pump with tubing, support cables, and power supply (may not be required if well yield is low)

III. Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.
2. A pump will be used for well purging if the well yield is adequate; otherwise, a bailer may be used.
3. Instruments are calibrated according to manufacturer's instructions.
4. The well number, site, date, and condition are recorded in the field logbook.
5. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be

placed only on the plastic sheeting until after the sampling has been completed.

6. Water level measurements are collected in accordance with SOP *Water Level Measurements*, and the total depth of the well is measured.

7. The volume in gallons of water in the well casing or sections of telescoping well casing is calculated as follows:

$0.052\ (\pi\ r^2h) = 0.163\ (r^2h) =$ gallons

where: $\pi = 3.14$

r = Radius of the well pipe in inches
h = height of water in well in feet

The volume of water in typical well casings may be calculated as follows:

2-inch diameter well:
0.163 gal/ft x ___ (linear feet of water) = gallons

4-inch diameter well:
0.653 gal/ft x ___ (linear feet of water) = gallons

6-inch diameter well:
1.469 gal/ft x ___ (linear feet of water) = gallons

The initial field parameters of pH, specific conductance, and temperature of water are measured and recorded in the field logbook. The measurement probes are inserted into the probe box. The purged groundwater is directed through the box, allowing measurements to be collected before the water contacts the atmosphere.

8. Sampling equipment is cleaned and decontaminated prior to sampling in accordance with SOP *Decontamination of Personnel and Equipment.*

9. If a bailer is being used, it is removed from either its protective covering or the well casing and attached to a cord compatible with constituents and long enough to reach the bottom of the well. If a sampling pump is being used, the airline, discharge line, and support cable or rope is attached to the pump. The support line should bear the weight of the pump. If the well is purged using dedicated tubing, it is lowered into the well to the top of the screened zone.

10. The sampling device is lowered to the well interval from which the sample is to be collected. The pump intake will be placed above the top of the screen, where possible. If a bailer is being used, it is allowed to fill with a minimum of surface disturbance to prevent sample water aeration. When the bailer is raised, the bailer cord must not touch the ground.

During purging, the field parameters are measured at least once for each well volume. In productive wells, the well purging end point is determined using the field measurements. In nonproductive wells, the well is repeatedly bailed dry to obtain a minimum of three well volumes, then allowed to recover before sampling.

12. Three to five well volumes are purged (more may be purged if parameters do not stabilize). Purging is stopped when field parameters have stabilized over three consecutive well volumes. Field parameters are considered stabilized when pH measurements agree within 0.5 units, temperature measurements agree within 1°C, and specific conductance and dissolved oxygen measurements agree within 10 percent.

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the log book:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs. Samples may

be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended method is through the use of a disposable in-line filtration module (0.45 micron filter) using the pressure provided by the pumping device for its operation. When a bailer is used, filtration may be driven by a peristaltic pump.

3. VOC samples from wells purged using dedicated tubing and a sampling pump will be collected using a bailer

4. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.

5. The bottle is capped, then labeled clearly and carefully.

6. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.

7. If the sampler is dedicated, it is returned to the well and the well is capped and locked. Nondedicated samplers are cleaned and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment.*

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:

- Inspect sampling pump regularly and replace as warranted
- Bring supplies for replacing the bladder if using a positive-displacement bladder pump
- Inspect tubing regularly and replace as warranted
- Inspect air/sample line quick-connects regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

2.7 Soil Borings

Before soil borings (or well borings) are initiated, utility clearances will be obtained from the Navy. Borings will be advanced by a tripod, truck-mounted, or all-terrain vehicle (ATV) drill rig, using a split-spoon sampler. The sampler is driven into unconsolidated materials using a falling weight connected to the drill rig.

If physical access to areas is restricted, soil borings may also be advanced using a hand auger or a tripod-mounted sampling device. The locations and total depth of hand-augered boreholes will be determined in the field based upon subsurface soil conditions and site specific sampling objectives.

The soil borings performed under these investigations will typically be sampled continuously (every 2-feet) or periodically (every 5-feet) to depth, as necessary, for lithologic and/or chemical characterization. A geologist will observe the drilling and sampling operations. The soil will be classified according to the Unified Soil Classification System (USCS). Field observations of lithology, moisture content, discoloration's, odors, and other visible features will be described and recorded in the field logbook. During advancement of the boring, a photoionization detector (PID) will be used to measure volatile organic contamination in the soil cuttings and split spoon samples. Subsurface soil samples may be analyzed from all or selected boreholes.

Upon completion, each boring will be backfilled with a bentonite-cement grout mixture. A labeled stake will be placed at the ground surface near the borehole for future reference. Asphalt or other surface material will be patched. Auger cuttings will be containerized in a roll-off. If significant contamination is present, either visually or by measurement from a PID, the soil will be drummed separately from the roll-off box, labeled with the appropriate boring number, and placed on a wooden pallet at the site. Soil cuttings from background locations will be spread on the ground near the borehole and not containerized.

2.8 Subsurface Soil Sampling

Split spoon sampling techniques will typically be used at locations where samples are being collected from depths greater than 3-5 feet, discreet sampling intervals, from beneath asphalt, or where compaction of the soil has made sample collection using manual augers or trowels impossible.

A drill rig will be used to advance 6 1/4-inch hollow stem augers to the top of the desired sampling interval. A stainless steel split-spoon sampling device will be attached to the proper length of drilling rod and inserted through the hollow stem augers. A 150-pound hammer will be used to advance the split-spoon sampling device up to 2-feet below the auger or until refusal as required for sample collection. The split spoon sampler will then be retrieved and the sample handled in accordance with site specific SAPs.

2.9 Monitoring Well Installation

Monitoring wells will be installed in selected boreholes. Boreholes drilled for monitoring well installation will be lithologically logged by the Field Geologist as described in

Section 2.7. Well locations will be determined based upon previous analytical results, or other pertinent field data, as described in the site specific work plans.

Monitoring well borings will usually be installed using hollow stem augers, unless field conditions require the use of a rotary method. The rotary method will utilize the addition of drilling water, not drilling mud. Well screens will be placed within the zone of interest. Specific well screen placement will be discussed in the Site-Specific Work Plans.

At locations where permanent wells are not required or well installation cannot be completed using a truck-mounted or ATV drilling rig, drive points may be installed. Drive points are 2-inch diameter, stainless steel monitoring wells with short screens that are installed by driving the well point into the ground. These will be installed in wet areas where the weight of a drilling rig cannot be supported, or because of steep slopes or dense forest. Drive points may also be installed in an open borehole.

2.9.1 Monitoring Well Construction

Monitoring wells will generally be constructed of 2- or 4-inch I.D., Schedule 40 polyvinyl chloride (PVC) risers and screen, with flush joint threads. Wells will typically have 10 to 15-feet screen lengths, depending upon aquifer thickness. Samples of aquifer material for grain size analysis may be collected from selected well borings. From this information, screen slot size and sand pack particle size will be determined. Wells will have a 2 to 3-foot sump, below the screen to catch small particles that may move through the sand pack. Wells may also be constructed of stainless steel rather than PVC in areas where high concentrations of solvents are present in the groundwater that could degrade a PVC well.

A sand pack will be placed around the screened interval to one to two feet above the top of the screen. A minimum of two feet of bentonite will be placed above the sand pack. If above the water table, bentonite will be hydrated with potable water prior to grouting. Grout will be placed via a side-discharging tremie pipe above the bentonite pellets to within one foot of the ground surface.

Drive points may be constructed in one of two ways. If the drive point is hammered into place, no other well construction will be necessary, and the well assembly is fabricated from 2-inch diameter stainless steel and includes a screen (anticipated to be 2-3 feet in length), casing, and a hardened point. If a hand augered borehole is used, the procedure will consist of:

- Advancing a 4-inch diameter hand auger to the desired depth below the water table.
- Installing a temporary casing if the borehole collapses using PVC pipe hammered into the collapsing borehole and reaugered to clean out the soils until final depth is achieved.
- Placing a 2-inch diameter drive point in the open borehole.
- Placing sand pack around the drive point to a depth that is approximately 1 foot above the screened interval.
- Placing a bentonite seal above the sand pack to the top of the borehole.
- Grouting will not be used in drive points.

In high traffic areas, wells will be completed with a flush mounted protective casing with locking cap. A 2-foot x 2-foot x 4-inch concrete pad will be installed in the asphalt or concrete to reinforce the shallow wells. This will be sloped away from the well to prevent surface water infiltration.

Wells completed where there is no vehicular traffic will have 2- to 3-feet of "stickup" above ground surface. A steel protective casing will be placed over the riser and cemented into a 4-foot x 4-foot x 4-inch concrete pad. Steel guard posts will be placed around the protective casing to prevent accidental damage. The pad will be sloped away from the well to prevent surface water infiltration.

2.9.2 Monitoring Well Development

Monitoring wells will be developed prior to groundwater sampling by removing water from each well using a disposable polyethylene bailer and clean rope, submersible pump, or bladder pump. The development water will be discharged into 55-gallon drums or other storage containers (e.g., tankers). A surge block also will be used to aid in development. If dedicated sampling equipment is not used, equipment will be decontaminated between wells.

Well development will be performed after the grout used to construct the well has been allowed to adequately set (at least 48 hours). The groundwater levels will be measured to the nearest 0.01 foot from the top of the PVC casing. Development will consist of removing at least three borehole volumes of water, plus the amount of water added during the drilling or installation process. Development will continue until the water clears, or until six hours of development has passed, whichever comes first. Water clarity will be measured with a nephelometric turbidity unit (NTU) meter. Development information, including water clarity, pH, specific conductivity, and temperature, will be recorded in the field logbook.

Wells installed as part of previous investigations will be evaluated in the field to determine if redevelopment is required. Redevelopment will be considered necessary if 10 percent or more of the screen length has been "silted in," that is, filled in by soil particles; this soil matter leads to turbid samples and possibly incorrect conclusions about groundwater analytical results. If redevelopment is necessary, it will follow similar procedures as for newly installed wells; however, additional time and volume of water removed may be needed to remove the fine sediment from the well.

After installation of drive points, the inside of each drive point screen will be scrubbed with a 2-inch diameter round steel brush to clean out any mud or sediment that might clog the screen slots. The water in the drive point will then be bailed out. If necessary, distilled water may be added and the screens scrubbed again to facilitate water flow through the screen. This procedure may be repeated two or three times to clean the screen.

2.10 Monitoring Well Abandonment

Well abandonment will be performed on monitoring wells which are no longer in use or which are improperly constructed. The well abandonment procedures are in accordance with the Virginia Department of Health. The objective of this procedure is to prevent

contamination from reaching groundwater through the well (Virginia Department of Health, April 1992). The well will be overdrilled using hollow stem augers and, if possible, the casing will be removed. The casing will be decontaminated, cut into small sections approximately 3 feet long, and disposed as regular trash. The well will be filled with grout by a tremie pipe that will extend to the bottom of the well. As the grout fills the well, the pipe will be raised.

2.11 Groundwater Sampling from Monitoring Wells

Monitoring wells will not be sampled for at least two weeks after the well has been developed. This will allow an adequate amount of time for the well to recover. Prior to sampling, groundwater will be purged from each well. Purging will be performed until the temperature, specific conductance, DO, Eh, and pH have stabilized to within 10 percent for three consecutive readings. Purging will be accomplished using low flow pumps or bailers. Well purging data will be recorded in the field logbook. The Investigation-Derived Waste Management Plan (IDWMP) discusses treatment and disposal of purge water.

Samples will be collected after the field parameter measurements have stabilized. Wells that are pumped dry during purging will be allowed to recover before sampling; the sample will be obtained as soon as a sufficient volume of groundwater to fill all sample containers has entered the well.

Groundwater samples will be collected from the well using a clean, double check valve bailer or low-flow sampling pump. The sample will be transferred from the bailer or the pump into properly-labeled, laboratory-prepared sampling containers filled and/or preserved as appropriate; cooled to approximately 4°C; and shipped to the analytical laboratory under appropriate CofC documentation procedures. Samples for dissolved metals analyses will be field filtered prior to preservation using a 0.45 micron filter. The filter will be prepared prior to use by rinsing with distilled water or otherwise following the manufacturer's instructions. Table 2-1 shows the required containers, preservatives, and holding times for water samples.

The objective for use of low-flow groundwater sampling is to pump in a manner that minimizes drawdown to obtain a representative groundwater sample. Typical flow rates are on the order of 0.1 to 0.5 liters per minute, but will be dependent on the site specific hydrogeology. The pump will be slowly lowered into the well and set at approximately the middle of the screen, and at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Purging rates for more transmissive formations could be started at 0.5 to 1 liter per minute. Surging the well will be avoided. The water level will be monitored during purging, and, ideally, the purge rate is set equal to the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.5 feet). The water level should stabilize for the specific purge rate and at least 1 foot of water maintained over the pump intake. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid affecting well drawdown. More detailed procedures for low-flow sampling are provided in the SOPs.

2.12 In-Situ Groundwater Sampling

Groundwater samples may be collected using a Geoprobe® hydraulic sampler or a HydroPunch hydraulic sampler mounted on a 4-wheel-drive truck where permanent wells are not installed and the extent of groundwater contamination needs to be defined. Prior to sampling activities, utility clearances will be performed. The borehole will be advanced using a drill rig and hollow stem auger techniques to reach the depth of interest in the aquifer. At that depth, the drill rods will be removed and the Geoprobe® or HydroPunch samplers hydraulically pushed to the zone of interest. The cover will then be retracted, allowing water to flow into the device. Groundwater samples will either be retrieved using a double check valve sampling tool or a "mini" bailer. Samples will be collected directly into sample containers that have been precleaned and preserved by the analytical laboratory, according to USEPA specifications.

Table 2-1 shows the required containers, preservatives, and holding times for water samples.

2.13 Aquifer Testing

Aquifer testing that may be conducted at NAB Little Creek includes slug tests, step-drawdown pumping tests, and constant-rate pumping tests.

2.13.1 Slug Tests

Rising and falling head slug tests may be performed in monitoring wells to evaluate aquifer hydraulic conductivity in the vicinity of the well. Slug tests will be performed after groundwater sampling, using solid PVC slugs with clean bailer rope. A pressure transducer attached to an electronic recording device, such as an In-Situ Hermit™, will be used to record changes in pressure associated with water level recovery. Tests will be repeated three times to verify reproducibility.

2.13.2 Step-Drawdown Pumping Tests

Step-drawdown pumping tests may be performed to ascertain the efficiency (specific capacity) of a well and to determine an appropriate pumping rate for conducting a constant-rate pumping test. Methodology will be described in site-specific work plans and field sampling plans.

2.13.3 Constant-rate Pumping Tests

A constant-rate pumping test might be performed on a well to ascertain the transmissivity and storage coefficient or storativity of the aquifer for use in modeling and capture zone analyses. Methodology will be described in site-specific work plans and field sampling plans.

2.14 Hydrologic Measurements

Groundwater or surface water hydrologic measurements may be collected at NAB Little Creek. Measurement procedures are described below.

2.14.1 Groundwater Level Measurements

Groundwater level measurements will be measured in monitoring wells and drive points. Fluid level measurements will be used to evaluate the movement of groundwater, the horizontal hydraulic gradient, the vertical hydraulic gradient, and the thickness of any free product, if present. This information, when combined with other site-specific information such as hydraulic conductivity, extent of contamination, and product density, may be used to estimate contaminant movement or source areas. Fluid levels will be measured with a water level indicator or oil/water interface probe, as appropriate. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot.

2.14.2 Surface Water Level Measurements

Surface water level measurements may be read from surveyed staff gauges placed in surface water bodies. Surface water level measurements will be used with groundwater measurements to help determine communication between surface water and groundwater. Depth of surface water bodies may be measured using a graduated weighted tape or similar device. Average width of the water body may be measured using a tape measure or a rangefinder. The relative velocity of a water body will be estimated if the velocity cannot be measured with a flow meter.

2.15 Test Pits/Trenching

Test pits or trenches may be completed in areas where characterization of fill or other waste materials is required or the extent of contamination needs to be determined. Test pits/trenches may be excavated up to 15 feet in length and to a maximum depth of ten feet. Samples of materials excavated from the trench will be collected from the bucket of the backhoe or the pile of excavated material using a stainless steel trowel or spoon. Test pits/trenches will not be entered by any member of the sampling team.

The position of the test pit/trench will be determined in the field by the Project Geologist/Scientist. Utility clearance will be conducted by a private subcontractor prior to excavation. Excavation equipment will be decontaminated prior to and after each test pit/trench excavation. Excavation will proceed by removing lifts of no more than about 6 to 12 inches, until an assessment of the material can be made. The material removed from the trench will be placed on plastic sheeting. A geologist will log the test pit materials. The cross section will be sketched or described and notable features will be identified in the field logbook. Depths will be measured from the ground surface. The length and width of the test pit will also be measured. The test pits/trenches will be backfilled with the material removed from the excavation immediately after completed to reduce site hazards and minimize the potential for rainwater accumulation and subsequent contaminant migration.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, Eh, and Temperature Using the Horiba® U-22 with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-22 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, Eh, and temperature of groundwater samples. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

III. Procedures and Guidelines

A. Parameters and Specifications:

Parameter	Range of measurement	Accuracy
pH	0 - 14 pH	+/- 0.1 pH units
Specific Conductivity	0 - 100 mS/cm	+/- 3 % full scale
Turbidity	0 - 800 NTU	+/- 5 % full scale
Dissolved Oxygen	0 - 19.9 mg/l	+/- 0.2 mg/l
Temperature	0 - 55 °C	+/- 1.0 °C
Eh	-1999 mv - +1999 mv	+/- 15 mV
Salinity	0 - 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using Horiba® Standard Solution. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the standard solution.
2. Fit the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O.

calibration is done using atmospheric air.

3. Turn power on.

4. Press CAL key to put the unit in the calibration mode.

5. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.

6. If the unit is calibrated properly, pH will read 4.0 +/- 3%, conductivity will read 4.49 =/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

As water passes through the flow-through Cell, press MEAS to obtain reading; record in the field notebook.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance
- Check batteries, and have a replacement set on hand

Note: The turbidity meter with the Horiba® U-22 often provides inaccurate measurements (readings of –10 or 999); it is recommended that a separate turbidity meter be used for field measurements.

2. Waste Handling

This section describes the waste handling procedures to be followed during the RI/FS and other environmental investigation activities on the Base. Site-specific procedures and methodologies for managing and handling IDW will be provided on the IDW checklist in the site-specific SAPs. The checklist will also reference the appropriate SOPs, located in the back of the MP, to follow when managing and handling IDW at the site.

2.1 Solid IDW

Solid wastes, including soils, soil cuttings, and non-soil wastes will be produced during field investigations. All IDW will be managed and disposed in accordance with this Master IDWMP and the SOPs. Different types of solid IDW are discussed below.

2.1.1 Soils and Soil Cuttings

Soil cuttings generated during field activities will be contained in 55-gallon drums, roll-off containers, or other types of approved containers if the existence of contamination at the site has either been confirmed or suggested from previous investigations, or if no previous site investigation has taken place. Soil to be contained includes the soil cuttings generated during any intrusive activity, and any soil that accumulates in the decontamination pad from the washing of drilling equipment. Drums will be sealed and appropriately labeled.

If previous investigations have confirmed that contamination does not exist at the site, soil cuttings generated during the field activities mentioned above will be returned to the borehole from which they were removed. Excess soil cuttings will be spread on the ground near the boring from which they were removed and graded and seeded as necessary. If the boring is located in an area with a maintained lawn, asphalt, or concrete surface, excess soil cuttings will be spread on the ground and graded and seeded at a location designated by the Navy.

At the conclusion of a drilling event, drums filled with potentially contaminated soil cuttings will be temporarily stockpiled at a location designated by Navy personnel. This location will be identified in the site-specific IDWMP. The Navy will then verify whether or not the site contains listed hazardous wastes, as specified in 40 CFR 261.

If the site does contain listed hazardous waste, the waste management subcontractor will dispose of the drummed soil as hazardous waste at a regulated hazardous waste landfill. If the site does not contain listed hazardous wastes, the waste management subcontractor will collect composite soil samples from the drums and submit the samples to an approved laboratory for the waste characterization analyses required by the proposed disposal facility.

If there is reason to suspect that the waste may contain asbestos, PCBs, or petroleum products, those analyses will be conducted to determine if the material meets the definition of a Virginia special waste as defined by Part VIII of the Virginia Solid Waste Management Regulations (see Section 3.5 of this IDWMP).

The drums will remain at the temporary location until the Navy, waste management subcontractor, or the environmental contractor receive the characterization sampling analytical results. The wastes must be handled and disposed of within 90 days of being stockpiled at the temporary location. For planning purposes, IDW will be stored at the Base for a maximum of 60 days in order to ensure compliance with the 90-day accumulation time.

Upon the receipt of these results, the environmental contractor will formulate a preliminary assessment of any potential hazards posed by the IDW and submit waste management recommendations to the Navy and, if requested by the Navy, to the Environmental Protection Agency (EPA) and Virginia state regulators. Recommendations will be based on the analytical results of soil and groundwater sampling conducted during field activities and on the results of characterization sampling. If the site's soil and groundwater sampling analytical results are "clean," and if the characterization sampling results do not contain listed hazardous wastes and are below Toxicity Characteristic Leaching Procedure and Resource Conservation and Recovery Act characteristic regulatory limits, the environmental contractor will recommend that the waste management subcontractor dispose of the soil at a non-hazardous waste disposal facility.

If the composite soil samples from the drums contain contaminant concentrations above the regulatory limits, the drummed soil will be considered hazardous. The waste management subcontractor will ship the hazardous waste to a regulated hazardous waste landfill where it will be either treated or stockpiled, as appropriate, and as directed by the Navy.

The proposed steps for accumulating, handling, and disposing of IDW soils and soil cuttings are as follows:

1. Verify with the Navy whether or not the site contains listed hazardous wastes, as specified in 40 CFR 261. If the site does contain listed hazardous wastes, as specified in 40 CFR 261.

2. If the existence of contamination at the site has either been confirmed or suggested from previous investigations, or if no previous site investigation has taken place, shovel soils and soil cuttings from the boring into 55-gallon drums or roll-off containers.

3. If previous investigations have confirmed that contamination does not exist at the site, return soils and soil cuttings directly into the boring from which they were removed. Excess cuttings will be spread on the ground surface near the boring from which they were removed or shoveled into 55-gallon drums if the boring is located in an area with a maintained lawn, asphalt, or concrete surface.

4. Stockpile drums or roll-off in the area(s) designated by the Navy.

5. Upon completion of field activities, if the site does not contain listed hazardous wastes, as specified in 40 CFR 261, notify the waste management subcontractor that drums are ready to be sampled for waste characterization.

6. The subcontractor will collect composite samples from the drums and submit them to an approved off-site laboratory for the analyses required by the proposed disposal facility.

7. Upon receipt of characterization results, write a memorandum to the Navy recommending whether to handle the soil as hazardous waste, Virginia special waste, or non-hazardous waste.

8. If the waste is considered non-hazardous, upon receipt of concurrence by the Navy, the waste management subcontractor will dispose of the soil in a non-hazardous landfill.

9. If the waste is considered hazardous, upon receipt of concurrence by the Navy, the waste management subcontractor will dispose of the waste at a regulated hazardous waste landfill where it will either be treated or stockpiled, as designated by the Navy. The Navy will be responsible for signing all manifests.

10. If the waste is considered a Virginia special waste, it will be disposed of as described in Section 3.5.

2.1.2 Non-soil Solids

The disposable personal protective equipment used by the environmental contractor's field personnel and their subcontractors will be placed in plastic bags and then in 55-gallon steel drums. Examples of PPE to be contained include nitrile gloves, tyveks, rubber boots, and respirator cartridges. Any expendable items that were used during sampling will also be contained in drums, such as in-line water filters, C-flex tubing, and paper towels. Drums will be sealed and labeled appropriately.

The PPE will be bagged and drummed pending receipt of sampling analytical results. If the sampling analytical results indicate that the site's soil and groundwater are non-hazardous, the PPE and sampling expendable items will be placed in marked bags and discarded in dumpsters. If sampling analytical results indicate that the site's soil and groundwater are hazardous, the handling and disposal procedures of PPE and sampling expendable items will be identical to those that apply for hazardous soils and soil cuttings.

2.2 Liquid IDW

Groundwater as IDW will be produced during monitoring well development and groundwater purging and sampling. Groundwater will be contained in 55-gallon drums, bladders, or other types of approved containers if previous investigations have either confirmed or suggested the existence of contamination at the site, or if investigations have not yet been conducted at the site. In addition, water generated during decontamination processes and excessive liquids that separated from soil cuttings will be added to drums containing groundwater IDW. Drums will be sealed and appropriately labeled.

If groundwater is extracted from a background location where contamination is not expected, or if previous investigations have confirmed that contamination does not exist at the site, the groundwater will not be contained during field activities.

At the conclusion of field activities, drums containing liquid IDW will be temporarily stockpiled at a location designated by Navy personnel. The contained wastes must be disposed of within 90 days of being stockpiled at the temporary location. For planning

purposes, IDW will be stored at the Base for a maximum of 60 days in order to ensure compliance with the 90-day accumulation time.

The Navy will then verify whether or not the site contains listed hazardous wastes, as specified in 40 CFR 261. If the site does contain listed hazardous waste, the waste management subcontractor will dispose of the liquid IDW as hazardous waste at a regulated hazardous wastewater treatment facility where it will be treated until it meets standards for disposal as appropriate, and as directed by the Navy.

If the site does not contain listed hazardous wastes, the environmental contractor will formulate a preliminary assessment of any potential hazards posed by the IDW and submit waste management recommendations to the Navy and, if requested by the Navy, to the EPA. Recommendations will be based on the analytical results of groundwater sampling conducted during field activities. If the site's groundwater sampling analytical results are "clean," the environmental contractor will recommend that the liquid IDW be disposed of as a nonhazardous waste water.

If the groundwater sampling results contain contaminant concentrations above RCRA hazardous waste criteria, the drummed water will be considered hazardous. The waste management subcontractor will ship the liquid IDW to a regulated hazardous wastewater treatment facility where it will be treated until it meets standards for disposal as appropriate, and as directed by the Navy.

The proposed steps for accumulating, handling, and disposing of IDW liquids are as follows:

1. Verify with the Navy whether or not the site contains listed hazardous wastes, as specified in 40 CFR 261. If the site does contain listed hazardous wastes, refer to step 7.

2. If previous investigations have either confirmed or suggested the existence of contamination at the site, or if investigations have not yet been conducted at the site, groundwater will be contained in 55-gallon drums or other suitable containers. In addition, water generated during decontamination processes and excessive liquids that separated from soil cuttings will be added to drums containing groundwater IDW. The drums will be sealed and appropriately labeled.

3. If groundwater is extracted from a background location where contamination is not expected, or if previous investigations have confirmed that contamination does not exist at the site, groundwater will not be contained during field activities.

4. Stockpile drums in the area(s) designated by the Navy.

5. If the site does not contain listed hazardous wastes, the environmental contractor will write a memorandum to the Navy recommending whether to handle the drummed water as hazardous or non-hazardous waste. The recommendations will be based on results of groundwater sampling conducted during field activities.

6. If the waste is considered non-hazardous, upon receipt of concurrence by the Navy, the waste management subcontractor will haul the liquid IDW offsite for treatment as a nonhazardous waste water.

7. If the waste is considered hazardous, upon receipt of concurrence by the Navy, the waste management subcontractor will haul the liquid IDW to a regulated hazardous wastewater treatment facility where it will be treated until it meets standards for disposal as appropriate, and as directed by the Navy. The Navy will be responsible for signing all manifests.

3. General Considerations

General considerations pertinent to the generation and handling of IDW are documented below. These include the minimization of waste volume, drum labeling and storage, and disposal and manifesting protocol.

3.1 Minimization of IDW Volume

To minimize the volume of IDW soil generated during drilling, cuttings will be used to backfill the boreholes from which they were removed when previous investigations have confirmed that contamination does not exist at the site. Only excess cuttings will then be contained as IDW.

IDW soil generated during trenching will be minimized by backfilling the trench pits with soil that was extracted from them during the excavation process. Excess soil will be graded with a backhoe in the vicinity of the filled trench.

To minimize the volume of IDW groundwater, only the minimum volume of discharge purge water necessary to stabilize the pH, conductivity, temperature, and other parameters, will be purged from wells. In addition, groundwater will not be contained if extracted from a background location where contamination is not expected, or if previous investigations have confirmed that contamination does not exist at the site.

3.2 Labeling Drums

Each 55-gallon drum containing IDW will be labeled with the following information: the type of IDW (groundwater, soil, PPE, etc.), the date the drum was filled and sealed, and a brief warning not to handle the drum or its contents without permission from the NAB Little Creek IR Program. The following is an example of the information to be included on each drum:

Investigation Derived Wastes
Purge Water from Site 7 - MW1
4-8-96
Do Not Handle - Analysis Pending
(757) 322-4751

3.3 Storing IDW

Drums containing IDW will be stockpiled at an on-site location designated by Navy personnel, pending the receipt of characterization and sampling analytical results. This location will be identified in the site-specific IDWMP. The drums must be covered and stored on pallets. The contained wastes must be disposed of within 90 days of being stockpiled at the temporary location. For planning purposes, IDW will be stored at the Base

for a maximum of 60 days in order to ensure compliance with the 90-day accumulation time.

3.4 Waste Disposal and Manifesting

Upon the receipt of characterization and sampling analytical results, the environmental contractor will assess the potential hazards posed by the IDW and submit waste management recommendations to the Navy. If the test results indicate that the IDW is not a listed or characteristic hazardous waste, the environmental contractor will recommend that soil be disposed of at a non-hazardous landfill, that water be disposed of at an industrial wastewater treatment plant, and that PPE and sampling expendable items be disposed of in a trash dumpster for disposal with other non-hazardous trash generated at the Base.

If the test results or the Navy indicates that the IDW is generated from a site that contains a listed or characteristic hazardous waste, the environmental contractor will recommend that the soil, water, and PPE be manifested, handled, treated, and disposed of as a hazardous waste by a waste management subcontractor. The waste management subcontractor will prepare manifests for a completeness review by the environmental contractor. NAB Little Creek will be responsible for signing all manifests.

3.5 Virginia Special Waste

In accordance with the Virginia Solid Waste Management regulations special wastes may require special handling precautions. There are several catagories of special waste including tires, appliances, and lead acid batteries; however, the special wastes that may be applicable to IDW generated at NAB Little Creek are likely to be limited to asbestos-containing waste materials, waste containing PCBs, and soils contaminated with petroleum products. All applicable solid waste disposable requirements for these special wastes will be adhered to as outlined in Part VIII of the regulations. A summary of protocols for managing IDW classified as special waste is described below:

- Asbestos containing IDW. IDW will be properly containerized in leak-tight containers while wet. For materials placed in double, 6-ml thick plastic bags and sealed, the outer plastic will be transparent. Containers or wrapped materials will be labelled using a warning that notes "contains asbestos fibers avoid creating dust: cancer and lung disease hazard."

- Wastes containing PCBs. Wastes containing PCBs at concentrations greater than 50 ppm will not be disposed of or stored without specific approval of the EPA. Solid wastes containing PCBs between 1 and 50 ppm are restricrted to disposal in sanitary landfills or industrial landfills.

- Wastes contaminated with petroleum products (diesel fuels, kerosene, gasoline, hydraulic fluids). Soils containing total BTEX greater than 10 mg/kg or TPH greater that 500 mg/kg will not be disposed of in a sanitary or industrial landfill unless the facility permit expressly allows such disposal. Soils containing TPH less than 500 mg/kg and total BTEX less than 10 mg/kg may be disposed of at permitted sanitary or industrial landfills with liners and leachate collection systems. Soils containing TPH

less than 100 mg/kg and total BTEX less than 10 mg/kg may be disposed of at any permitted sanitary or industrial landfill. Soils containing less than 50 mg/kg TPH and total BTEX less than 10 mg/kg may be used a clean fill.